STUDIES IN ATMOSPHERIC BIOELEMENTS

THESIS

SUBMITTED FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

BOTANY

BY

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M. Sc.

UNIVERSITY OF ALLAHABAD
ALLAHABAD
1996

CERTIFICATE

Certified that the thesis embodies results of original work and study, carried out under my supervision by Ghazala Shakeel Khan from 1990 to 1996. Certified further that this work has not been submitted for any degree anywhere else by her.

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Supervisor

ACKNOWLEDGEMENTS

I owe a debt.of gratitude to my reverent teacher Dr. (Mrs.) Manju Sahney for her guidance in the present work. She has been a great source of encouragement which inspired me to carry out work on this interesting topic.

Professor D. D. Pant has always been a great source of inspiration by way of his personal interest in the progress of work and lending books and reprints form his personal library, housed in the Botany Department.

I sincerely thank Professor D. D. Nautiyal, former Head of the department for providing me the necessary laboratory and library facilities. I am also grateful to him for his encouraging help.

I am grateful to Professor B. K. Verma, Professor G. K. Srivastva, Dr. D. R. Mishra, Dr. P. K. Khare, Dr. (Mrs.) Nupur Bhowmik, Dr. S. P. Tiwari, Dr. Rita Singh and Dr. P. Srivastava for their help and encouragement.

My special thanks are due to Dr. D. K. Chauhan, Dr. S. K. Chaturvedi and Dr. Shonali Chaturvedi, who have always been generous with help in various ways.

I am thankful to Dr. Anoop Chaturvedi of Statistics Department for his help in correlation studies and to Mr. Naseem Ahmad of Computer Centre for punching out the weather data. For availing the computer facility, I am specially thankful to Dr. K. K. Bhutani, Director, University Computer Centre.

To my colleagues and friends in the laboratory, specially Mrs. Charu Gupta and Mrs. Sangeeta Agarwal, who have always lend me helpful hand, I am deeply thankful.

I also acknowledge the help of Drs. Meena Rai, Achala Srivastva, Rohini Sahni, Manju Srivastva, Anil Shukla and Pradeep Shukla.

I am greatly indebted to my parents and my husband Mr. S. A. Khan for bearing with me with patience in my present endeavour.

Ghazala S. Khan.

(GHAZALA S. KHAN)

Contents

CHAPTER - I

INTRODUCTION

INTRODUCTION

The atmosphere, the earth's life supporting system for plants and animals, is constantly being contaminated by air pollutants causing damage to man, animals and plants. Among the inorganic pollutants are gases, soot, dust, grit etc. is being constantly added to the atmosphere by man-made sources such as industries, automobiles, primitive forms of heating etc. The organic particulates are microorganisms originating from natural sources, comprising of pollen grains, spores, algal elements, viruses, bacteria, minute insects, mites and detached parts of plants and animals, and also from man-made organic sources such as garbage dumps which add to the atmospheric spore populations, particularly those of fungal forms. The study of such atmospheric microorganisms was termed as "aerobiology" by Fred C. Meier (1935). W. C. Jacobs (1951) elaborated the term to include their dispersal in the atmosphere and impaction on all forms of life (See Mandal & Chanda, 1984)

The British Aerobiological Federation defined aerobiology as the scientific discipline focussed on the transport of organisms and biologically significant materials through the atmosphere, Spicksma (1992) described aerobiology as consisting of three main phenomenon: the release of micronic particles from their source, their dispersal through the medium of air and finally the deposition or settling of these particles on different substrates at various locations.

HISTORICAL BACKGROUND

The presence of harmful microorganisms in the air was first of all described by Hippocrates, the father of medical science, who held that man was attacked by epidemic fevers when he inhaled air with pollutants hostile to the human race (See Cunningham, 1873). Darwin in 1846 analysed dust deposited on the vessel *Beagle* over the Atlantic ocean and reported that airborne particles

might be transported hundreds of miles by wind across the oceans. Ehrenberg (1849) gave evidence of the existence of an atmospheric "kingdom of life" during the period 1830-47. His closer study of the cholera epidemic of 1848 led to the recognition of air as the carrier of many common germs. Pasteur (1861) demonstrated the existence of an airspora by rough visual measurements of its concentration in the atmosphere of Paris. His apparatus consisted of a fine tube through which air was drawn by means of filter pump and the particles were caught on a plug of guncotton attached to the other end of the tube, the volume of air pumped-in being measured by displacement of water. He trapped several thousands of microorganisms carried in suspension per cubic metre of air. Salisbury (1866) used glass sheets to examine the night air in marshy areas over Ohio and Mississipi, in connection with the spread of malaria. Maddox (1870) invented an "aeroconiscope" for collecting atmospheric particles, the working of which depended on wind currents .

Cunningham (1873) was the first person to describe and illustrate different microorganisms viz., pollen grains, fungal spores, nematodes and bacteria from the air of Calcutta, India. With his "aeroconiscope" he sampled air over two prisons in Calcutta where cholera and other fevers were rife. He also tried to establish relationship between airborne microorganisms and the prevalence of the so called "zymotic" diseases whose etiology was then unknown. He also correlated his data with meteorological parameters, inferring that moist weather appeared to increase the total number of airborne viable fungal spores. The results of his studies he presented in his book "Microscopic examinations of air".

Blackley (1873) surveyed the air of Manchester to record the pollen content. He exposed slides at breathing levels and above at 1500 feet using kites and discovered that wind and rain were two significant factors causing increase

and decrease in the airborne pollen concentrations. He adopted the so called "gravity slide method" to catch the aerial pollen.

Miquel (1883) was the first to use volumetric methods to make a steady long term survey of the microbial content of the atmosphere in Paris. Further he also studied microbial populations of air at high altitudes in the Alps, those over the sea and also in rain water. By using glycerined slides and culture method he estimated fungal spores and bacteria, studied hourly variations of the spores, and changes in relation to seasons, weather, place and altitude. Hesse (1884) in Germany worked on similar lines. His apparatus consisted of a horizontal narrow tube lined with nutrient gelatin. He found that mould germs trapped from the atmosphere were lighter than bacterial germs and concluded that fungal spores occurred as solitary particles but the bacteria were present either as large groups or attached to larger carrier particles in the atmosphere. Explorations of the upper air for microbial populations were conducted by Harz (1904), with the use of a balloon over southern Bavaria and by Stakman et al (1923) & Scheppegrell (1924, 1925) by using aeroplanes over the Mississipi Valley. Stakman found fungal spores and pollen grains at altitudes up to 3300 metres; while Scheppegrell recorded pollen grains at heights upto 5800 metres, but their highest concentrations were in between 300-1000 metres. Weston (1929) too found fungi and bacteria abundant up to 3000 metres in England but their density lowered above this altitude. Air upto 3000 feet above the Arctic ocean was surveyed by Meier et al (1933, 1935) and up to 36,000 feet by Rogers & Meier (1936) and they reported occurrence of algae, diatoms and insect wings as well.

Erdtman (1938) during a voyage from Gothenburg to New York conducted volumetric survey of pollen grains and found those of trees, shrubs, herbs and grasses in the air over the middle of the Atlantic Ocean. Further he found that number of pollen grains in the marine air was correlated with the

distance from land, direction and velocity of the wind and flowering periods of the plants. Vareschi (1935, 1942) made a quantitative analysis of pollen grains in glaciar ice and correlated the data with ice movement and stratification and also with wind.

Durham (1935, 1942) in North America and Hyde (1952) in Britain were first to make systematic surveys of airborne pollen and fungal spores. Durham (1935, 1942, 1943, 1944, 1946, 1947, 1954) studied the atmospheric pollen and fungal spore content of North America extensively. He proposed a standard method of gravity sampling, counting and volumetric interpolation of results, and made several surveys of airborne pollen and fungal spores of various localities using gravity slide and volumetric methods. Hyde (1952, 1956, 1959a) studied in detail the atmospheric concentrations of grass, tree and weed pollen in Great Britain. He surveyed the air for pollen allergens at Cardiff, (with Adams, 1958, 1968) and studied their diurnal variations and influence of situation and weather (with Williams, 1945, 1950).

Gregory (1961) did extensive work in the field of aerobiology and coordinated the available information in his book "Microbiology of the atmosphere". He proposed the term "airspora" to describe airborne pollen grains and fungal spores.

Wodehouse (1971) in his book "Hay Fever .Plants" presented the distribution and description of common plants causing hay fever in the United States; and also gave an account of aeropalynological surveys conducted there.

That the airborne pollen grains were the probable cause of hayfever was surmised by Elliotson (1831) but it was Blackley (1873) who confirmed the same by performing inhalation experiments on himself and later demonstrated that grass pollen grains caused hay fever, while Wyman (1876) recognised ragweed pollen the cause of autumnal hay fever in the United States. Noon (1911)

obtained results in the treatment of hay fever by the subcutaneous injection of pollen extracts.

Van Leeuwan (1924) suggested that asthma was caused by " miasmata" or " climatic allergens" like *Aspergillus, Mucor* and *Penicillium*. Cadham (1924) made reports on the airborne wheat rust spores and their role in allergy. Hansen (1928) and Jimenez Diaz et al (1931) worked on the role of fungal spores in causing climatic asthma.

APPLIED ASPECTS OF AEROBIOLOGY

Aerobiology is an integrated and multidisciplinary science. Besides its crucial importance in medicine, it has application in the field of ecology, quarternary stratigraphy & archaeobotany, phytopathology, plant breeding and meteorology etc.

Medicine - The concept of aeroallergens gained recognition through the works of Hyde & Adams (1958) in Britain and that of Wodehouse (1935) in America. It is a well established fact that the airborne pollen grains and spores are the main cause of certain forms of human allergy like seasonal rhinitis, asthma and rarely eczema (Blackley, 1873; Shivpuri, 1964; Chanda & Mandal, 1980, 1984; Chanda 1987, 1992). The airborne pollen, spore and other biological elements have the capacity to form skin sensitizing and reaginic antibodies through the immune system of the body thereby initiating allergic responses in susceptible individuals. Long term monitoring of allergens at different places, their annual and seasonal variations and their forecasts are of utmost importance to the allergist for the treatment of the patients.

Ecology - Transport of pollen by wind is an important mode of pollination to secure reproduction and survival of many plant species. Certain airspora constituents such as moss and fernspores, seeds, plant propagules are potential

colonizers of new land areas. Regular surveillance of aerospora can perceive changes in vegetation caused by afforestation and reforestation, invasion of foreign species, progress of airborne diseases and changes in the phenology of source plants (Stakman & Harrar 1957) thereby avoiding introduction of new species which cause additional allergens in the atmosphere.

Quaternary stratigraphy - Aerobiological studies are helpful in tracing back the history of present day flora & fauna of an area. Bioelements in the atmosphere are washed out by rain or are deposited in soil. Analysis of sediments from soils streams, lakes etc. can be used in the reconstruction of vegetational succession in the geological past, thereby revealing changes in climatic conditions over the past period. (Moore et al, 1991)

Phytopathology - Continuous monitoring of airborne pathogens like fungi, bacteria and viruses helps in identifying spore stages, predict infection time and probable damage to crop plants and also in minimizing their harmful effects (Stakman & Christensen, 1946; Nilsson, 1992). Farmers can therefore be alerted beforehand against the probable airborne invasion of plant diseases.

Plant Breeding - In breeding experiments for forest plantations and for growing high quality crops, controlled pollination is an asset to achieve good fruit setting by means of high quality pollen. In certain anemophilous plants like *Vitis* and *Olea*, monitoring of airborne pollen is helpful in predicting the crop yield (Cour et al, 1980).

Meteorology - By using airborne pollen as markers, general atmospheric circulations of air pollutants can be studied. Recent pollen and spore rain correlated with various meteorological parameters enables scientists to reconstruct natural ecosystems and past climates (Cour et al 1980).

AEROBIOLOGICAL STUDIES IN INDIA

More than half century had passed after Cunningham's (1873) pioneering work on aerobiology in India at Calcutta when scientists seriously took up work on aerobiology on a systematic basis in the subcontinent. It was Chatterjee (1931) and later on Mehta (1933) who reported occurrence of pollen-grains and spores from 62 different stations from various parts of the country. At present there has been abundance of reports on atmospheric pollen, fungal spores and other plant materials in different biozones of India.

AEROPALYNOLOGICAL STUDIES

Northern Region - In North India initial studies on airborne pollen were conducted by Shivpuri & Coworkers in 1957 (Shivpuri et al, 1960). Slides were exposed for two consecutive years at different sites with a view to correlate airborne pollen counts with respiratory allergy (Dua & Shivpuri, 1962). Singh and Shivpuri (1971) prepared pollination calender and identified more allergenic pollen grains of Delhi atmosphere. Later fresh aeropalynological surveys were conducted for three years at different sites to study the diurnal variations and seasonal periodicity of pollen allergens at Delhi (Singh & Babu, 1980a, 1980b, 1980c, 1982). Further, Malik et al (1990, 1991) investigated the air of Delhi at human height.

Using aeroscopes, Lakhanpal & Nair conducted atmospheric pollen surveys at Lucknow (1958) and Almora (1960). Later more aeropalynological surveys were conducted in Lucknow by Vishnu-Mittre & Khandelwal (1973) and Chaturvedi et al (1989). Similar aeropalynological investigations were made at At Allahabad by Nautiyal & Midha (1978, 1984a, 1984b) Meerut city by Gaur

(1978), at Modinagar by Gaur & Bhati (1980), at Bareilly by Kumar (1984), at Rudranath by Gaur & Kala (1984), and at Srinagar by Munshi (1992, 1994).

Southern Region - Pioneering work in this region was done at Vellore by Nair (1963) followed by work of Reddi at Anakapelle and Vishakhapatnam (Reddi, 1970; Janakibai & Reddi, 1982).

At Bangalore, Agashe & Coworkers conducted extensive surveys of airborne pollen grains in relation to pollen incidence, pollen productivity, seasonal and diurnal variations, meteorology and immunotherapy (Agashe & Vinay, 1975, 1980; Anand, Agashe & Manjunath 1983; Agashe & Chatterjee 1987, Agashe & Abraham 1988, 1990-91, Agashe & Alfadil, 1989 and Awasthi & Agashe, 1994).

Further aeropalynological studies in the southern region were made by workers like Appanna (1978, 1980) at Vijayawada, Ravindran (1988) and Gopi et al (1990) at Trivandram and Calicut, Atluri et al (1992) at Vishakhapatnam, Satheesh et al (1992, 1993a) at Kodaikanal and Tiruchirapalli, Anupama (1992) at Pondicherry, Atluri & Devi (1992) at Rajahmundry, Maribhat & Rajasab (1992) at Gulbarga, Devadoss et al (1994) at Madras and Onkarappa & Ramalingam (1994) at Dharwad.

Gopi et al (1992) conducted aeropalynological surveys of the midlands of Kerala at five centres, Using Cour's trap, a three year aeropalynological survey of a wet evergreen forest was made at Uppangala by Tissot & Caratini (1994).

Eastern Region - Cunningham (1873) was the first to carry out aerobiological work at Calcutta. After a gap of 100 years Chanda and Coworkers of Bose Research Institute, Calcutta, resumed work on aerobiology in relation to

respiratory allergy and organic environmental pollution. Aerobiological surveys were conducted at many centres in West Bengal to determine the types of pollen allergens present in the atmosphere, their seasonal variations, biochemical compositions and their correlation with the meteorological parameters. The role of pollen as environmental pollutants with reference to respiratory allergy and also in monitoring and control of pollution has also been investigated (Chanda & Mandal, 1978, 1979, 1980a, 1980b, 1980c; Mandal, 1982). The centres where work was carried were Greater Calcutta, (Chanda & Nandi, 1971; Chanda & Sarkar, 1972; Chanda, 1973; Banik & Chanda, 1986), Calcutta (Chanda et al, 1978), Suburban Calcutta, Salt Lake City (Bhattacharya et al, 1984) and Krishnapur (Nandi et al, 1985) Central Calcutta (Banik & Chanda, 1990, 1992), Rural Calcutta at Madhayamgram (Banik & Chanda, 1990), Kalyani (Chanda, 1973; Mandal et al, 1977; Mandal & Chanda, 1980; Chanda & Mandal, 1981), Falta (Chanda, 1973; Mandal et al, 1977), Darjeeling (Kundu et al, 1981, 1982a; Mandal, 1982), Kurseong (Kundu et al, 1982b; Mandal et al, 1982; Gupta et al, 1985; Gupta & Chanda, 1989), Cooch Behar (Majumdar et al, 1988; Majumdar & Chanda, 1994) and Mirik (Mandal & Yonzone, 1989).

In the eastern region aeropalynological studies were also conducted at Gauhati (Baruah & Chetia, 1966; Bora & Baruah, 1980), Shillong (Singh, 1981), Imphal (Singh & Devi, 1992) and Patna (Bandopadhyay & Kathuria, 1989).

Western Region - Aerobiological work in the western region of the country was initiated at Army Medical College at Poona by Kalra & Dumbrey (1957) and Kalra & Wonchoo (1958) in relation to the incidence of allergic disorders. Atmospheric pollen flora of Pune was again investigated in 1964 by Chaubal & Deodikar. Other places of this region where pollen surveys were conducted were Jaipur (Sanghviet et al, 1957; Kasliwal et al, 1959; Sarna & Govil, 1979), Kolhapur (Chaubal & Gadwe, 1979; Chaubal & Kotmire, 1982), Aurangabad (Tilak & Vishwe, 1976, 1980; Tilak 1989); Bombay (Dosi & KulKarni, 1981),

Nasik (Mahajan, 1985); Bhavnagar (Datta, 1989) and Chalisgaon (Nandode & Tilak, 1994).

Central Region - In Central India aeropollen flora of Nagpur was studied and pollen calendar was prepared by Deshpande & Chitaley (1976). Further work on aeropalynology was done by Tripathi et al (1977, 1981) at Bhopal and by Oomachan et al (1988) at Jabalpur.

Aeromycological Studies

Northern Region - In north India first aeromycological survey for a period of one year was conducted by Rajan et al (1952) at Kanpur to estimate the frequency of cellulose destroying fungi. Extensive work on the aeromycology in relation to allergy has been done at Vallabhbhai Patel Chest Institute, Delhi. Using culture plate and slide method, Agarwal & Shivpuri (1974) conducted a two year aeromycological survey at Delhi to determine the incidence of fungal spores, their diurnal and seasonal variations and their role in respiratory allergy. The incidence of fungal spores in the air of Delhi in relation to the spread of allergic disorders were also studied by Agarwal et al (1967, 1969). Saxena et al (1968), Agarwal et al (1974) and Singh & Babu (1983).

At Gorakhpur, elaborate aeromycological studies were made by Mishra & Kamal (1967, 1971, 1977), Mishra & Srivastava (1970), Mishra (1971), and Kamal & Verma (1977). Surveys were conducted over paddy, wheat and barley fields and over a lake, to study the seasonal variation of airborne fungal spores.

Aeromycological surveys were also carried out at Agra (Agarwal & Gupta,1966), Varanasi (Mishra, 1966), Lucknow (Vishnu Mittre & Khandelwal,1973; Wadhwani 1979), Allahabad (Nautiyal & Midha, 1978, 1984a), Meerut (Gaur, 1980), Balrampur city (Srivastava & Shukla, 1990) and in a pine forest in the Himalayas (Kumar, 1982).

Southern Region - Work on the aeromycoflora in South India was pioneered by Sreeramulu (1958, 1959, 1960). Using the Hirst spore trap he surveyed the air over the Mediterranean to estimate the concentration of spores and pollen grains (1960). He also conducted surveys over paddy fields near Pentapadu (with Seshavataram, 1962) and Vishakhapatnam (with Ramalingam, 1963, 1964, 1966). Further, he observed the diurnal and seasonal periodicity of certain plant pathogens in the air (1959) and effect of weather conditions (1964) and mowing (1958) on the spore content of the atmosphere.

After Sreeramulu several other workers also took up airborne fungal spore study such as Nair (1963) at Vellore, Reddi (1970) for comparative studies at Ankapalle and Vishakhapatnam, Ramalingam (1966, 1971), Vittal with Krishnamoorthy (1981) and Shenoi & Ramalingam (1976a, 1976b) at Mysore, Rati & Ramalingam (1976) in particular relation to airborne As - pergilli at Mysore, Vittal & Ponnuswamy (1979, 1982) at Madras; Nagendran et al (1978) at Bangalore; Mari Bhat & Rajasab (1991) at Gulbarga; Nayal (1993) at Safilguda, a semiurban area near Secunderabad, Satheesh et al (1993b) at Tiruchirapalli and Kodaikanal (1994), and Awasthi & Agashe (1994) at both urban and rural sites at Bangalore.

Circadian periodicities of some common airborne fungal spore types were recorded by Reddi (1974), Shenoi & Ramalingam (1975) in Mysore and Awasthi & Agashe (1994) in Bangalore.

Shenoi & Ramalingam (1980) studied the airborne microbes precipitated in rain while Ramalingam & Nanjundaiah (1982) studied the aerospora as being a source of soil inoculum.

Eastern Region - In eastern region aeromycological work was pioneered by Padmanabhan et al (1953) at Cuttack to report the occurrence of airborn

conidia of *Helminthosporium oryzae* over paddy fields. Significant work was done by Konger & Baruah (1958) in Shillong and Baruah & Chetia (1966) in Gauhati. Aeromycology of Shillong was again investigated by Singh et al (1981) to study the seasonal periodicity of *Cladosporium* spores and of Gauhati by Sarma & Sarma (1993) for 5 years to study the diurnal and seasonal variations. At Calcutta, aeromycological work was taken up by Chakravarty (1974) and Sinha et al (1980-1981). Further work in the eastern region was carried out at Imphal (Singh & Devi, 1992), Senapati district (Singh & Dorycanta, 1992) and at Shantiniketan for five years in relation to respiratory allergy (Raha & Bhattacharya 1992).

Western Region - Aeromycological work in the west was initiated by Kalra & Dumbrey (1957) at Pune. In Maharashtra extensive work has been done by Tilak and his school of aerobiology at Aurangabad. Airspora survey were conducted at Aurangabad by Tilak & Srinivasulu (1967), Tilak & Vishwe (1979, 1980), Tilak et al (1981). Studies were also conducted in particular:

References to the aerial incidence of various classes of fungi such as ascosmycetes (Tilak & Srinivasulu, 1971; Tilak, 1975; Kulkarni & Tilak, 1983) Basidiomycetes (Tilak et al, 1982) Deuteromycetes (Tilak & Bhalke, 1978) Zygomycetes (Tilak & Kulkarni, 1975), hyphal fragments (Tilak & Bhalke, 1981). Tilak (1989, 1990) reviewed the role of various fungal spore types as aeroallergens and investigated particularly the types that were reported to be allergenic. At several other places in the western region, aerobiologists conducted surveys for aerial spora concentrations viz. at Jaipur (Gupta et al, 1960), Parbhani (Talde, 1961), Bombay (Dosi & Kulkarni, 1981; D'Silva & Freitas, 1982), Nanded (Pande 1982) and Sri Ganganagar city (Singh & Grewal, 1989).

Central Region - Work on the airborne fungal spora monitoring in the central region was initiated by Mehortra & Claudis (1967) at Sagar. Chitaley & Bajaj (1973, 1974, 1975), using an aircraft at Nagpur recorded the airspora at high altitudes. Another survey at Nagpur was conducted by Bajaj (1978) for spores affecting crops. At Jabalpur extensive work was conducted by Verma & co-workers (Verma & Khare 1988, 1990, 1991; Verma, 1990, Verma & Chile, 1991) at both urban and rural areas (Verma, 1988, 1989) in relation to biopollution studies (Verma & Khare, 1987) and allergy (Verma & Chile, 1992). Airspora studies at Raipur were reported by Tiwari & Sahu (1994).

AEROBIOLOGICAL STUDIES OUTSIDE INDIA

Extensive work has been carried out and there is a volume of literature in the field of aerobiology at the international level.

Aeroplaynological Studies

Africa - Saad (1958ab, 1959)surveyed the atmospheric pollen grains and spores at Alexandria to study daily incidence, diurnal variations of pollen grains and their correlation with weather conditions. Cour et al (1980) made interregional studies of pollen incidence from Lapland to North Africa. An aeropalynological survey was conducted offshore west African provinces of Mauritiana and Senegal by Caratini & Cour (1980), to establish relationships between airborne pollen, the productive continental vegetation areas and the trade wind directions. Hawke & Meadows (1989) conducted aeropalynological studies of Capetown, Cadman (1991) at Johannesburg & Pretoria and Cadman & Dames (1993) at Durban.

America - Work on the aerobiology of the United States was initiated by Durham (1946, 1954) who dealt with atmospheric pollen as a cause of respiratory allergy there. Naranjo (1958) studied airborne pollen in Central and

South American countries. Shapiro et al (1965) conducted field studies and correlated meteorological data with a three-year atmospheric pollen survey at southern California. The aeropalynoflora of the city of Washington was studied by Aldoory et al (1980) and Anderson et al (1988).

In Canada, aerial investigations for pollen were carried out by Basett (1964) in Manitoba and Saskatchewan, whereas by Collins-Williams et al (1971) in Toronto. Pollen abundance in the air of Argentina was reported by Majas & Romeo (1992).

Arctic and Ant arctic Island - Polunin (1954, 1955) conducted aerobiological surveys of the Arctic air by exposing sticky slides and reported occurrence of pollen grains and possible moss spores. Pollen grains in the air of the Arctic Island of Jan Mayen were investigated by Johansen (1991).

Asia - Kessler (1958) and Keynan et al (1991) studied the abundance of Pine pollen in the air of Israel. Effect of warm, dry desert winds on airborne pollen concentrations were also investigated by them.

Ikuse et al (1962) surveyed airborne pollen grains of Tokyo. Higuchi et al (1977) studied the aerial incidence of Japanese cedar, *Cryp tomeria japonica* as a cause of pollinosis in Japan.

Jingtan (1964) explored the air of West Beijing in China for incidence of pollen. Chaudhary & Singh (1994) sampled airborne pollen at Kathmandu Valley in Nepal while Gungor & Ozturk (1994) investigated the air of Manisa (Turkey) for two consecutive years.

Australia And New Zealand - In Australia airborne pollen studies have been conducted by Meier (1941) in the city of Adelaide, by Derrick (1965), Smart & Knox (1979) and Ong et al (1995) in Melbourne and by Moss (1965)

in Brisbane. Hillas & Willson (1979) studied pollen abundance in the air of Auckland.

Europe

Britain - Aerobiological work in Great Britain was pioneered by Hyde & Williams (1944, 1945), Hyde (1950a, b) and Hyde & Adams (1958) to study pollen deposition at Cardiff as influenced by weather and situation. Brown & Jackson (1973) conducted aerobiological survey of eight sites within a 60 km. radius at Derby. Emberlin et al (1990, 1991) and Norris Hill & Emberlin (1991) carried out aeropalynological studies to construct tree pollen calendars and to study annual and diurnal variations of pollen concentrations in air and to correlate them with weather variables. At Liecester, Hart et al (1991) studied the vertical differences in airborne pollen concentrations.

Bulgaria - In Bulgaria extensive work has been done on the aeropalynology of Varna and Sofia by using sedimentation method and later on by volumetric methods(Bozilova and Yankova 1976, Yankova 1989, 1991, 1994).

Denmark - Strandhede & Wihl (1981) compared the aeropalynological results of Copenhagen and Malmo in Denmark.

Finland - To study distinct regularity in their diurnal variations extensive surveys of airborne tree and non-tree pollen were conducted by Kapyla (1981, 1984) in Finland.

France - In France, atmospheric pollen studies were done by Charpin et al (1966) and Michel et al (1976) at Grenoble while by Bousquet et al (1984) at Montpellier. In Southern France, Meiffren (1988) made comparative studies of airborne pollen of Toulouse with those of Bordeaux and Montpellier.

Greece - Giolekas et al (1994) made observations on the airborne pollen of *Olea europea* and its clinical significance in Thessaloniki (Greece).

Italy - In Italy, pollen abundance in the air of Trieste was monitored by Rizzilongo and Cristofolini (1987) for eight years, by Caramiello et al (1990) at Turin and in Central Italy at Perugia by Bruno et al (1994). Negrini et al (1994) investigated the airborne *Ambrosia* pollen in Genoa over a period of 13 years, while Spieksma et al (1989) presented annual sums of average daily pollen concentrations of *Alnus, Poaceae* and *Artemisia* known to cause allergic sensitization in patients in Central Italy.

Netherlands - Extensive work has been done in the Netherlands by Spieksma and his coworkers in the field of aeropalynology (Spieksma 1985, Spieksma et al 1989, 1991, Jager, Spieksma & Nolard 1991, Driessen et al 1991).

Spieksman (1985) studied the airborne pollen concentrations in Lieden from 1977-1981. Grass pollen abundance was studied in relation to their allergenic significance by Spieksma et al (1991). Pollen abundance in the air of Stockholm was also investigated by Nilson & Persson (1981), Janzon (1981) and Atkinson & Larsson (1990).Driessen et al in the Netherlands. Fluctuations in daily airborne pollen incidence form year in Vienna, Leiden and Brussels were recorded by Jager et el (1991).

Norway - To gain information in connection with the establishment of pollen forecast service in Norway, Ramfjord (1991) sampled air for two consecutive seasons.

Portugal - Obtulowicz et al (1990) conducted airborne pollen survey in Poland to correlate the occurrence of pollen allergy symptoms. Airborne pollen content at Evora (Southern Portugal) was sampled by Brandao & Lopez (1994)

to correlate respiratory disease response in 116 sensitive patients to specific pollen types.

Russia - In Russia, Ado et al (1971) made atmospheric pollen investigations of Moscow, Krasmodar and Andizhan to study herbs and spring tree pollinosis of the air of Kiev (Ukraine).

Spain - Losada et al (1994) presented qualitative and quantitative record of airborne pollen at Santiago de Compostela while in Granada, Guardia et al (1995) studied the Gramineae pollen in the atmosphere in relation to pollinosis.

Switzerland - Leuschner & coworkers made systemtatic studies on the airborne pollen in Switzerland (Leuschner 1973, 1974a, 1974b, 1990, 1994). Investigations of pollen content of the atmosphere had been carried out since 1969 (Leuschner 1974) and a record of 21 year of study was presented by Leuschner (1990) from 13 different stations of Switzerland. Grass pollen abundance was also studied by Leuschner (1990) at Basel, Davos and Weisen.

In Northern Europe pollinosis due to Betulaceae and in the Meditterranean region due to *Parietaria* and *Olea* was investigated by D'Amato & Spieksma (1990). Comparative examinations of daily pollen concentrations of *Betula* at five European stations were carried out to study long term fluctuations in airborne pollen quantities by Spieksma et al (1994).

AEROMYCOLOGICAL STUDIES

Extensive work on aeromycology was done by Durham (1935, 42) in North America at various localities by using gravity slide and volumetric methods. He also proposed a standard method of gravity sampling, counting and volumetric interpolation of results. Hyde & Williams (1949) conducted studies at urban and rural areas of Cardiff for airborne *Clad.osporium* spores. Further

studies on aeromycology were conducted by Shapiro et al (1965) in South California, Goodmann et al (1966) in the dry conditions of Phoenix, Arizona, Turner (1966) in Hongkong, Joy Royes (1987) in Jamaica, Al Frayh et al (1988) in Saudi Arabia, Abdel Hafez & El Said (1989) in Wadi Qena, Egypt; Cadman (1991) in Johannesburg and Pretoria, Hasnain (1992) in Auckland, (New Zealand), Olonitola et al (1994) in Zaria, (Nigeria) and by Shrestha & Sharma (1994) in Kathmandu (Nepal).

Gregory (1962) and Dransfield (1966) laid emphasis on the contribution of fungi growing on plant surfaces to the atmospheric mould concentrations. Eversmeyer & Kramer (1987) investigated the spore content over a wheat field at Manhattan to study the onset of crop diseases. Stern (1994) gave an account of an increase in concentrations of *Didymella* ascospores after a thunderstorm in Leicester.

STUDIES ON AIRBORNE PTERIDOPHYTIC SPORES

Systematic studies on the airborne pteriodophytic and bryophytic spores are sporadic and there are very few reports on this aspect. Sreeramulu & Ramalingam (1961) experimented on the dispersion of *Lycopodium* and *Podaxis* spores in the air. Devi et al (1980) surveyed the allergenically significant fern spores and spor angial wall fragments present in the air. Devi & Yasmeen (1982) conducted a survey to study the dispersal and distribution of airborne fern spores and laid emphasis on the relationship between spore dispersal and number of fertile fronds, number of spores, extent of maturity and individual characteristics of the spores.

Nautiyal & Midha (1984a, b) reported the occurrence of pteridophytic and bryophytic spores, in the atmosphere of Allahabad.

STUDIES ON AIRBORNE ALGAL FRAGMENTS

Information on aerophycoflora is rather scant. It was in 1844 that presence of airborne algae in samples of dust collected over the Atlantic Ocean was reported by Ehrenberg. Molisch (1920) discovered diatoms in dust rains and called them "aeroplankton" while Meier & Lindbergh (1935) reported algae in the air of Greenland.

Systematic surveys on airborne algae were conducted by Marie Van Overeem (1936, 1937) in Netherlands. After her pioneering work several workers from different parts of the globe carried subsequent research viz. Peterson (1940) and Schlichting (1961, 1969, 1974) from Finland, Gregory et al (1955) and Hamilton (1959) from Great Britain , Gregory & Sreeramulu (1955) from Thorney Islands, Stevenson & Collier (1962) from United States and Tiberg et al (1983) from Sweden.

In Mexico, Roy-Ocotola & Carrera (1993) studied the effect of environmental pollution on airborne algal concentrations and also meteorological parameters like evaporation and turbulent kinetic energy on the dispersion of algae.

In the Indian subcontinent study on the airborne algal fragments was initiated by Ramalingam in 1971 at Mysore. Subsequent reports on the aspect were presented by Mittal et al (1973, 1974) from Delhi. Tilak & Vishwe (1978) from Aurangabad, Balkrishnan & Gunale (1980) from Poona, Marathe & Reddy (1980) from Nagpur, Singh (1981) from Shillong, Nautiyal & Midha (1984a) from Allahabad, Singh & Talapasai (1989) from Banaras, Srivastava & Shukla (1990) from Balrampur city, Khandelwal (1992) on airborne diatoms from Lucknow, Verma & George (1996) on Cyanophycean forms from Jabalpur and Singh (1996) from Imphal.

STUDIES ON OTHER AIRBORNE BIOLOGICAL PARTICLES

The first to record occurrence of other biological particles from the air such as mites, insect wings, and scales were Kalra & Dumbrey (1957) at Poona. Work on similar lines including plant parts also was taken up by workers like Nair (1963) at Vellore, Chaubal & Deodikar (1964) at Poona, Sreeramulu & Ramalingam (1966) at Vishkapattanam, Ramalingam (1971) at Mysore, Vishnu Mittra & Khandelwal (1973) at Lucknow, Tilak (1974) at Aurangabad, Sarna & Govinl (1979) at Jaipur, Gaur & Bhati (1980) at Modinagar, Gaur & Kala (1984) at Rudranath, Mahajan (1985) at Nasik and Jain (1990) at Gwalior. Pant, Nautiyal & Midha (1979-80) studied the atmospheric plant and insect parts at Allahabad and compsoed them with the microfossils of the saline series.

Airborne insect parts, mite populations and aphids were investigated by Reddi (1970), Dar et al (1974), Tilak & Bhalke (1975) and Bhagat & Bhat (1991).

AEROBIOLOGICAL STUDIES OF THE INDOOR ATMOSPHERE

Airborne pollen and fungal spore studies of indoor environments such as hospitals, libraries, residences and schools have been conducted for its effect on the human population. Tilak & Chakre (1977) studied indoor microbial composition of air in relation to storage diseases of crops. Aerobiological work inside homes was taken up by a handful of workers such as Tilak & Patil (1982), O'Rourke et al (1984), Singh (1985), Banerjee et al (1987), Yankova (1991), Agashe et al (1992), Raghu & Vittal (1992), Levetin (1994) and Rosas et al (1994).

Yankova (1991) took into account the influence of distant vegetation on the composition and quantity of pollen in inhabited rooms. Agashe et al (1992)

selected the residences of four nasobronchial allergy patient with a Boehm's personal sampler and cultural plate technique.

Airborne fungal spores inside and outside slum dwellings in Madras city were investigated by Raghu & Vittal (1992). Levetin (1994) made noteworthy investigations on the prevalence of Basidiomycete spores in indoor air while Rosas et al (1994) presented a study of airborne fungi within homes of 30 asthmatic patients in Mexico during day hours.

Aeromycological studies inside libraries were carried out by Chaturvedi et al (1981), Paradkar & Munshi (1987), and Singh et al (1990). Chaturvedi et al (1981) also conducted aerofungal flora studies inside a herbarium at Lucknow.

Notable surveys on the aerobiology of hospital wards were undertaken by Tilak et al (1980, 1982) and Tilak (1989) for airborne pollen and fungal spores while at Jabalpur by Verma & Chile (1991, 1992) for fungal spores only. An extensive survey of the indoor airborne fungal spora of various working An extensive environments was conducted in Calcutta for three consecutive years by Santra & Chanda (1989). Dominant aerofungal types from hospital wards, markets, libraries and jute mills were recorded by them. The air mycoflora of a sugar factory was studied by Pandit & Singh (1992) at Delhi and that of a flour mill by Mishra & Jamil (1991) at Lucknow.

Raha & Bhattacharya (1992) gave a comparative account of five indoor and five outdoor selected sites for detailed study of the fungal flora in the atmosphere at Shantiniketan for one year.

Levetin (1995) presented data on the range of bioaerosol levels that existed in school rooms at different times of the day.

POLLEN PRODUCTION STUDIES WITH REFERENCE TO AEROBIOLOGY

Pollen production study is useful in interpretation of data on pollen content of the atmosphere (Erdtman, 1956) and also essential in understanding the dispersal biology of airborne pollen grains in relation to allergic diseases (Chanda & Mandal, 1980). Studies on pollen production were made in relation to aerobiology and allergy (Nair & Rastogi, 1963; Singh & Shivpuri, 1975; Agnihotri & Singh, 1976; Janaki Bai & Reddi, 1980; Singh and Chaudhary 1981; Nautiyal & Midha, 1984b and Agashe & Soneenadin, 1992) and also in relation to their dissemination in the atmosphere (Mandal & Chanda, 1977; Bera 1990).

AEROBIOLOGICAL STUDIES IN RELATION TO METEOROLOGY

Meteorological conditions are said to be directly correlated both with the phenology and the subsequent airspora concentration of a particular area. Individual pollen types were considered to respond differently to different meteorological parameters (Agashe & Alfadil, 1989).

Workers who have correlated the incidence of airborne particles with one or several of the following meteorological factors viz. temperature, windspeed, sunshine hours,rainfall, humidity and total cloud cover are Hyde (1950, 1952), Sreeramulu & Ramalingam (1964), Davies & Smith (1973), Ljungkvist et al (1977), Singh & Baruah (1979), Spieksma et al (1989), Caramiello et al (1990), Cadman (1991), Hasnain (1993), Hjelmroos (1993), Hart (1994) and O'Rourke (1994).

AIM AND OBJECTIVES OF THE PRESENT WORK

The aerobiota of an area mainly reflects the ground vegetation of that particular place and since there is always a possibility of change in the

ground flora particularly of a city due to increased urbanization and introduction of alien species along the years, intermittent aerobiological surveys of that area become imperative. More than 10 years had passed since the earlier survey was conducted at Allahabad during 1973-1979, (Nautiyal & Midha, 1978, 1984a, b; Nautiyal & Sahney 1985), hence a need arose for fresh survey of atmospheric bioelements work taking into consideration several new aspects which had not been undertaken before :-

1 - New Methods of sampling were introduced such as the Durham gravimetric sampler and the Burkard 7-day volumetric spore trap.

2 - Comparative surveys of two areas were conducted, one in open green surroundings and another in a residential area in the suburban part of the city, 8 kms away from each other.

3 - Indoor aeropalynological surveys were conducted at 3-indoor sites viz. library, laboratory and hospital to record infiltration of outdoor pollen in the indoor atmosphere.

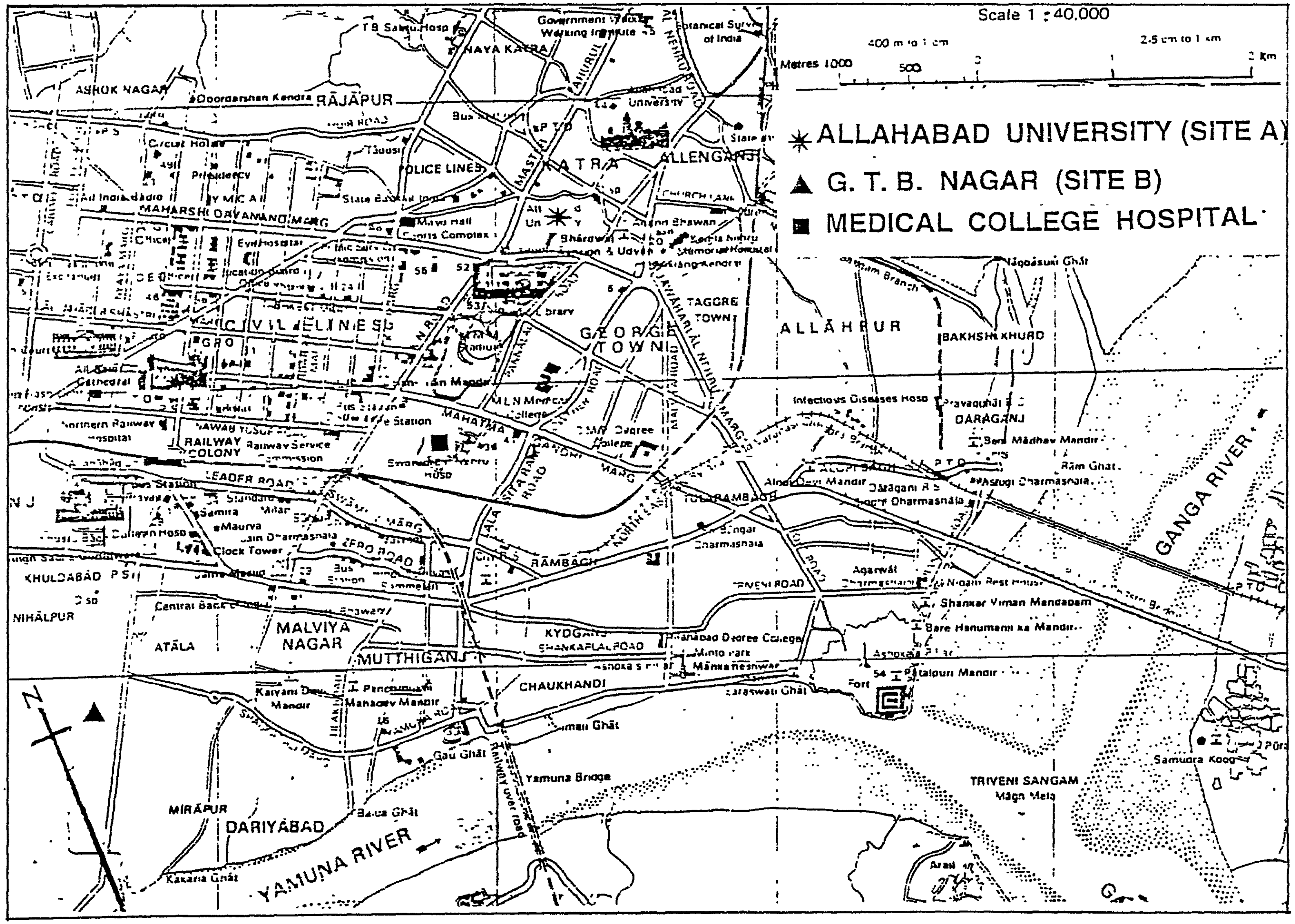
4 - Diurnal variations of common airborne pollen and spore types have been recorded with the help of the volumetric spore trap.

5 - Computerized correlation of the yearly pollen incidence as well as of common airborne pollen types with different meteorological parameters were also made.

6 - Pollen production studies were made of some selected plants.

CHAPTER - II

MATERIALS AND METHODS


Scale 1 : 40,000
Metres 1000 500 0 1 2 Km
ALLAHABAD UNIVERSITY (SITE A)
G. T. B. NAGAR (SITE B)
MEDICAL COLLEGE HOSPITAL
ASHOK NAGAR
RAJAPUR
NAYA KATRA
KATRA
ALLENGANJ
POLICE LINES
MAHARSHI DAYANAND MARG
CIVIL LINES
GEORGE TOWN
TAGORE TOWN
ALLAHPUR
BAKHSHI KHURD
DARAGANJ
RAMBAGH
RAILWAY COLONY
LEADER ROAD
MALVIYA NAGAR
MUTTHIGANJ
KHULDABAD
NIHALPUR
ATALA
CHAUKHANDI
MIRAPUR
DARIYABAD
YAMUNA RIVER
GANGA RIVER
TRIVENI SANGAM
Yamuna Bridge
Fort
Clock Tower

Text-fig. 1

MATERIAL AND METHODS

Present work is based on day to day monitoring of atmospheric bioelements for three years from 1990 to 1992. For the exposure of slides two sites were selected at a distance of eight kms. from each other.

Site A - is the Botany Department of the University of Allahabad which is in an open area in the north of the city. On its south side lies the lush green Chandra Shekhar Azad park, with diverse vegetation.

Site B - is a residential area in the south of the city with few avenue trees and patches of wild plants. On its south, two kms. away, flows the river Yamuna. Along the river sides are wastelands and a few farms.

Following surveys were conducted at the two sites :-

Survey I - was conducted from 1st September 1990 to 31st August 1991 at site A, using a gravimetric sampler as suggested by Lakhanpal & Nair (1958). The apparatus was placed at the height of 11 meters on the roof of the Maheshwari Morphogenesis Laboratory, situated in the Roxburgh Botanical Garden.

Survey II - was conducted from 1st January to 31st December at site A, at the same height of 11 meters, using a Burkard seven day volumetric trap, to study the number of bioelements per cubic meter of air and the diurnal variations of different pollen and spore types.

Survey III - was carried out again at site A at the height of 11 m using a Durham gravity sampling device from 1st February 1991 to 31st January 1992.

Survey IV - This survey was conducted at Site B from 1st February 1991 to 31st January 1992 using Durham gravity sampler. The apparatus was placed at a height of 6.6 meters on the roof of a building.

Indoor Surveys -

Comparative surveys of three different indoor environments were conducted for a period of three months from 1st February 1992 to 30th April 1992, at library, laboratory and a hospital ward. A comparative outdoor survey was conducted side by side for the aforesaid period at site A.

Indoor sites:

Library - It is situated inside the main building of Botany Department, at a height of 8 m from the ground level on the first floor and the room in which the experiment was performed is cut off from direct access. However there are three ventilators but they always remain close.

Science Laboratory - It is one of the research laboratories on the ground floor of the Botany Department. It has 2 doors and 6 windows, of which only one window opens towards the garden.

Hospital ward - It is one of the hospital wards on the first floor at a height of 8 m from the ground level of Swaroop Rani Nehru Medical College Hospital, situated at a distance of 2 kms on the south of Allahabad University in a fairly open area. It has a single entrance and twenty windows. About 5-10 windows remained open during the period of investigation.

Exposure, preparation and scanning of slides - While conducting gravimetric surveys, slides coated with a thin layer of safranin glycerine jelly were exposed daily for 24 hours except on Sundays and holidays . To avoid contamination, the slides were taken to and brought back from the site in closed petridishes. They were mounted in glycerine jelly with 25 X 50 mm size coverslip. The entire area under the coverslip was scanned in several sweeps in order to ensure the counting of all types of bioelements deposited on the slide.

In the Burkard volumetric trap, air is sucked in through the 2mm wide orifice, across a sticky tape at the rate of 10 litres per minute, and the drum rotates at a speed of 2mm per hour for periods of one week. The adhesive (9 parts vaseline and 1 part paraffin wax in toluene) was applied on the tape with a fine brush. The tape was mounted on a rotating drum driven by clockwork which enabled recording of the time variations during the day. To avoid contamination, the drum was taken to the site in a closed box. The exposed tape was similarly brought back to the laboratory after a week. The tape was cut into seven 48 mm pieces, each denoting 24 hour catch; and mounted on separate slides in safranin glycerine jelly. Care was taken not to mount the tape fragments reverse or out of order. The slides were scanned by the method proposed by Kapyla & Pentinen (1981). 12 transverse traverses 4mm apart were counted for obtaining the mean data of each 24 hours. Number of particles per cubic meter of air was calculated by using the following formula:

$$Y_V = \frac{(l.Y.)}{(dt.V)}$$

Where Yv = Mean number of particles m^{-3} of air derived from the sample.

l = length of the tape corresponding to one hour

y = estimated mean number of particles per one sampling unit.

dt = width of one traverse.

v = volume of air collected during one hour.

Due to trap malfunction during the months of May and November, data of only 5 days in each of the months could be recorded.

Field surveys .and preparation of reference slides - Plants growing around the sampling sites were surveyed from time to time to observe their flowering periods. Their polleniferous material was also collected to make the reference slides. Reference slides were made by two methods -

(1) For a ready comparison with airborne pollen grains slides were made by Wodehouse (1935) method. In this method there is no change in the pollen size and the protoplasmic contents are not removed except for the only resinous substances from the pollen surface.

(2) For morphological study of atmispheric pollen, referance slides were made by Erdtman's acetolysis method (1943).

Identification of airobiota - Identification of pollen grains and spores of pteridophytes and bryophytes was done with the help of reference slides prepared from the ground flora and also with the help of available literature. Identification of aeropollen was done upto the generic or specific level but in certain cases upto the family level viz. Poaceae, Amaranthaceae - Chenopodiaceae, Araceae, Cyperaceae, Solanaceae, and some members of Apiaceae, Arecaceae, Astercaceae, Malvaceae, Rutaceae, Urticaceae and Moraceae. While some grains could be identified only up to phyllum level viz., Monocotyledons. Identification of fungal spora and algal fragments is based on descriptions and illustrations in the available literature (Smith, 1933; Desikachary, 1959; Ellis, 1971, 1976; Nair et al, 1986, Tilak 1989)

Morphological descriptions - Each pollen and spore morphotype is accompanied by a short morphological description. Pollen grains are classified into different shapes and size as proposed by Erdtman (1952). The terminology as proposed by Faegri & Iverson (1950), Erdtman (1952) and Erdtman & Vishnu Mittre (1956) have been followed . The characteristics of pollen grains are based

on the shape and size of the grains; number, position and character of apertures and exine ornamentation. Size of pollen grains are based on the average measurments of 5 specimens.

For fungal spore descriptions terminology of Ainsworth & Bisby (1950) and Ellis (1971, 1976) is followed.

Photomicrographs - have been taken with a Leitz Biomed microscope. Unless otherwise specified, all pollen grains, spores and fungal spores are magnified upto 1200. The magnification of plant and animal fragments are as specified.

Pollen production studies - Pollen production of selected plants was done by the drop method and the Haemocytometer method.

Drop method - A single anther was gently crushed in 10 drops of 50% glycerine and shaken thoroughly. Five drops were mounted on different slides and the number of pollen grains in each droplet was counted under the microscope. Ten such samples were prepared and five readings from each were taken. Thereby, number of pollen grains per anther was calculated.

Haemocytometer method - For this method, Oberle & Goetzen's (1952) technique was followed. 20 samples of 100 anthers each were collected from mature unopened flower buds from different plants; and transferred to glass vials. 2.5 ml of 50% glycerine was added to each vial and the anthers were gently crushed with a glass rod. A dry coverslip was put over the two chambers of the haemocytometer. A drop of the sample was placed at one end of the coverslip; which spreads slowly to both the chambers. Number of anthers in each of the eight corner squares was counted and 4 such readings were taken for each sample.

Pollen grains per anther was calculated by the following formula :-

Pollen grains per ml X original volume of sample / 100

Abbreviations -

Where necessary abbreviations have used in the thesis as follows :-

AM.PR = Aspergillus - Mucur - Pencillium - Rhizopus,

BST = Burkard Spore Trap,

DGS = Durham Gravity Sampler,

LNS = Lakhanpal & Nair Sampler

Statistical Analysis

Correlation coefficients have been calculated using the following formula:-

$$r = \frac{N\sum XY - \sum X \sum Y}{\sqrt{\left[N\sum X^2 - \left(\sum X\right)^2\right] \times \left[N\sum Y^2 - \left(\sum Y\right)^2\right]}}$$

where N = number of pairs of observations, Y and X are variables.

Value of correlation coefficient 'r' between frequency of outdoor and dominant indoor allergenic pollen morphotypes was calculated for Y against X_1, X_2 and X_3.

Y = Weekly frequency of pollen grains in outdoor environment.

X_1 = Weekly frequency of pollen grains in laboratory environment.

X_2 = Weekly frequency of pollen grains in library environment.

X_3 = Weekly frequency of pollen grains in hospital environment.

Similarly for the correlation between daily incidence of pollen grains and different weather parameters, correlation coefficient 'r' was calculated for Y against X_1, X_2, X_3, X_4, X_5 and X_6.

Y = number of pollen grains

X_1 = maximum daily.temperature

X_2 minimum daily temperature

X_3 = mean daily temperature

X_4 = rain fall

X_5 = mean wind speed

X_6 = mean relative humidity

Physiography of Allahabad

The city of Allahabad is centrally located in the north Indian state of Uttar Pradesh. It lies between latitudes 24°47′ N and 25°47′ N and longitudes 81°9′ E and 82° 21′ E covering an area of 117 km from east to west and 101 km from north to south. The city lies at the confluence of the rivers Ganga and Yamuna flowing on the north eastern and south eastern borders respectively. Allahabad forms a part of the Gangetic plain with a vegetation consisting of grasslands, trees and shrubs, growing in the lush green parks and gardens of the city and along roadsides and avenues. The natural forests lie only on the hillocks in the south of the district.

The climate of Allahabad can be distinctly categorized into three seasons, viz., a cool and dry winter, a hot long summer characterized by hot winds, the "loo" and a short rainy season. There are two transitional periods, one after the winter and second after the rainy season.

The weather date of the period September 1990 to August 1991 is presented in Table 1.

TABLE 1 METEOROLOGICAL DATA OF ALLAHABAD FROM SEPTEMBER 1990 TO AUGUST 1991

MONTHS	MEAN MONTHLY TEMPERATURE (^{o}C)			MEAN MONTHLY RAINFALL (mm)	MEAN WIND SPEED (Km/h)	MEAN RELATIVE HUMIDITY (%)
	MAXIMUM	MINIMUM	MEAN			
SEPTEMBER	33.7	25.5	29.06	7.6	13	85
OCTOBER	32.8	21.4	27.1	0.19	6	76
NOVEMBER	30.4	14.8	22.5	-	7	71
DECEMBER	26.1	9.7	17.9	0.08	7	80
JANUARY	22.9	7.6	15.26	0.55	8	81
FEBRUARY	28.1	12.8	20.47	0.36	11	70
MARCH	33.9	17.2	25.54	0.18	14	56
APRIL	38.7	22.0	30.36	0.23	16	34
MAY	42.7	27.8	35.21	0.14	17	43
JUNE	37.6	28.0	32.8	10.05	13	65
JULY	36.0	27.8	31.9	3.79	15	74
AUGUST	31.8	25.8	28.78	7.66	13	88

CHAPTER - III

OBSERVATIONS

TABLE 2 DATA ON THE PHENOLOGY AND MODE OF POLLINATION OF SOME IMPORTANT PLANTS OF ALLAHABAD

S No.	PLANT NAME	FLOWERING PERIOD	MODE OF POLLINATION
1.	*Abutilon indicum*	Mid Nov - Mid May	EN
2.	*Acacia nilotica*	Mar - Nov	AM
3.	Acanthaceae	Feb - Apr	EN
4.	*Aegle marmelos*	May - Jun	EN
5.	*Ailanthus excelsa*	Mid Jan - May	AM
6.	*Alnus sp.*	Sep - Nov	AN
7.	*Alternanthera sessilis*	Aug - Apr	AN
8.	Amaranthaceae - Chenopodiaceae	Throughout the year	AN
9.	Araceae	Nov - May	EN
10.	Arecaceae	Almost throughout the year	AN
11.	*Arg emone mexicana*	Mid Oct - May	AM
12.	*Artemisia sp.*	Sept - Oct	AN
13.	Asteraceae	Almost throughout the year	EN
14.	*Azadirachta indica*	Mar - May	AM
15.	*Barringtonia acutangula*	May - Aug	EN
16.	*Bauhinia purpurea*	Nov - Mid Mar	EN
17.	*Bombax ceiba*	Feb - May	EN
18.	*Borassus flabellifer*	Mar - May	AM
19.	*Bougainvillea sp.*	Almost throughout the year	EN
20.	*Brassica sp.*	Nov - Apr	AM
21.	*Cajanas cajan*	Oct - Mar	SP, EN
22.	*Callistemon citrinus*	Almost throughout the year	EN
23.	*Cannabis sativa*	Dec - Apr	AM
24.	*Caryota urens*	Throughout the year	AN
25.	*Cassia spp.*	Jan - Oct	AM
26.	*Casuarina equisetifolia*	Feb - Jul	AN
27.	*Celosia cristata*	Oct - May	EN
28.	*Clarkia sp.*	Mid Jan - Mid Apr	EN
29.	*Coleus sp.*	Oct - Apr	EN
30.	*Convolvulus prostatus*	Mid Feb - Apr	EN
31.	*Coriandrum sativum*	Jan - Apr	EN
32.	*Coronopus didynamus*	Jan - Mar	AM
33.	*Croton bonplandianum*	Throughout the year	AM
34.	Cyperaceae	Throughout the year	AN
35.	*Delonix regia*	Apr - Jul	EN
36.	*Dianthus sp.*	Jan - Mar	EN

S No.	PLANT NAME	FLOWERING PERIOD	MODE OF POLLINATION
37.	*Drypetes roxburghii*	Feb - May	AM
38.	*Emblica officinalis*	Mar - May	AN
39.	*Ephedra foliata*	Nov - May	AN
40.	*Eucalyptus sp.*	Mid Dec - Apr	AM
41.	*Feronia limonia*	Apr - Jun	EN
42.	*Gnaphalium sp.*	Mid Dec - May	EN
43.	*Gomphrena globosa*	Mid May - Jan	AM
44.	*Holoptelea integrifolia*	Mid Jan - Mar	AN
45.	*Iberis amara*	Mid Jan - Mar	AN
46.	*Impatiens balsamina*	Sep - Nov	EN
47.	*Justicia sp.*	Aug - Mar	EN
48.	*Lathyrus odoratus*	Jan - Apr	EN, SP
49.	*Madhuca longifolia*	Apr - May	AM
50.	Malvaceae	Almost throughout the year	EN
51.	*Mangifera indica*	Mid Feb - May	EN
52.	*Milletia peguensis*	Apr - Jun	AM
53.	*Mirabilis jalapa*	Mid Mar - Jan	EN
54.	*Morus alba*	Feb - Jun	AN
55.	*Murraya koenigii*	Feb - Mid Apr	EN
56.	*Ocimum sanctum*	Oct - Mid Jun	EN
57.	*Parkinsonia aculeata*	Mid Dec - May	EN
58.	*Parthenium hysterophorus*	Throughout the year	EN
59.	*Peltophorum pterocarpum*	Apr - Mid Oct	EN
60.	*Phlox drummondii*	Mid Dec - Apr	EN
61.	*Phoenix sylvestris*	Jan - Apr	AN
62.	*Pinus roxburghii*	Mid Feb - Apr	AM
63.	*Pithecelobium dulce*	Mid Feb - Apr	AM
64.	*Plantago sp.*	Mid Nov -Feb	EN
65.	Poaceae	Throughout the year	AN
66.	*Polyalthia longifolia*	Mar - May	EN
67.	*Polygonum plebeium*	Jan - May	AM
68.	*Pongamia pinnata*	Mar - May	AM
69.	*Portulaca sp.*	Mid Apr - Jul	EN
70.	*Prosopis juliflora*	Almost throughout the year	AM
71.	*Psidium guajava*	Mar - Apr, Aug - Sept	EN
72.	*Pterospermum acerifolium*	Feb - Apr	EN
73.	*Ricinus communis*	Mid Nov - Mar	AN
74.	*Rorippa dubia*	Sept - Apr	AM
75.	*Roystonea regia*	Throughout the year	AM
76.	*Rumex dentatus*	Feb - May	AM

S No.	PLANT NAME	FLOWERING PERIOD	MODE OF POLLINATION
77.	Rutaceae	June - Mar	EN
78.	*Samanea saman*	Mar - May	EN
79.	*Santalum album*	Mid Jul - Mar	EN
80.	Solanaceae	Jul - Sept	EN
81.	*Spathodea sp.*	Jan - Mid May	EN
82.	*Spergula fallax*	Feb - May	EN
83.	*Strychnos nux vomica*	Mid Jan - Jul	EN
84.	*Syzygium cumini*	Apr - Jul	EN
85.	*Tamarindus indica*	May - Aug	EN
86.	*Terminalia arjuna*	Apr - May	AM
87.	*Thespesia sp.*	Mid Aug-Feb, Mid May-Jun	EN
88.	*Thuja sp.*	Mid Jan - Mar	AN
89.	*Tinospora cordifolia*	Feb - Apr	AM
90.	*Toona ciliata*	Mid Jan - Mar	AM
91.	*Typha australis*	Mar - May	AN
92.	*Xanthium strumerium*	Jul - Dec	AM
93.	*Zea mays*	June - Aug	AM

AN = Anemophilous, AM = Amphiphilous, EN = Entomophilous, SP = Self pollination

OBSERVATIONS

MORPHOLOGICAL DESCRIPTIONS

ANGIOSPERMS

DICOTYLEDONS

Morphological descriptions of each pollen morphotype is accompanied by its aerial incidence in various surveys. The families are arranged alphabetically and the respective genera in each family are arranged in alphabetical order as well.

ACANTHACEAE :

Justicia sp. L. (Pl.2, Fig.1) Grains prolate, size small (20 X 15 μm), amb circular, 3-zonicolporate, exine reticulate, reticulations larger around the equator.

1990 - 91 Survey :	Total number of pollen grains : 39
Site A	Period of occurrence : Dec, Feb, Mar
	Maximum occurrence : Feb (32)
	Minimum occurrence : Dec (1)
	Percentage contribution : 0.09

AMARANTHACEAE

Alternanthera sessilis (L) D.C. (Pl.2, Fig.3) Grains spheroidal, size small, dia. 14μm, amb circular, panporate, 12 forate, pore large in size (dia 8μm) exine reticulate, simplibaculate, muri pentagonal.

1990 - 91 Survey : Total number of pollen grains : 7

Site A Period of occurrence : Sep, Oct, Feb, Apr, May, Aug

Maximum occurrence : Oct (2)

Minimum occurrence : Sep, Feb, Apr, May, Aug

Percentage contribution : 0.02

1990 - 91 Survey : Total number of pollen grains : 2

Site B Period of occurrence : Sep, Dec

Maximum occurrence : Sep, Dec (1)

Minimum occurrence : Sep, Dec (1)

Percentage contribution : 0.02

Celosia cristata L. (Pl.2, Fig.7) Grains spheroidal, size rather small, (28μm), amb circular, panporate, exine surface with small projections.

1990 - 91 Survey : Total number of pollen grains : 9

Site A Period of occurrence : Dec, Mar, Apr

Maximum occurrence : Mar, Apr (4)

Minimum occurrence : Dec (1)

Percentage contribution : 0.02

1991 - 92 Survey : Total number of pollen grains : 2

Site A Period of occurrence : Mar

Maximum occurrence : Mar (2)

Minimum occurrence : Mar (2)

Percentage contribution : 0.02

1991 - 92 Survey : Total number of pollen grains : 1

Site B Period of occurrence : May

Maximum occurrence : May (1)

Minimum occurrence : May (1)

Percentage contribution : 0.012

1991 Survey : Total number of pollen grains : 14 m^{-3}

Site A Period of occurrence : Oct, Dec

Maximum occurrence : Oct, Dec (7 m^{-3})

Minimum occurrence : Oct, Dec (7 m^{-3})

Percentage contribution : 0.04

Gomph rena globosa L. (Pl.2, Fig.4) Grains spheroidal, size rather small (27μm), amb circular, panporate, exine reticulate, meshes large, hexagonal, each provided with a pore, simplibaculate, carinimurate.

1990 - 91 Survey :	Total number of pollen grains : 2
Site A	Period of occurrence : Oct
	Maximum occurrence : Oct (2)
	Minimum occurrence : Oct (2)
	Percentage contribution : 0.005

1991 - 92 Survey :	Total number of pollen grains : 1
Site A	Period of occurrence : Jul
	Maximum occurrence : Jul (1)
	Minimum occurrence : Jul (1)
	Percentage contribution : 0.01

AMARANTHACEAE Juss./CHENOPODIACEAE Vent.(Pl.2, Fig.2, 5, 6) Grains spheroidal, size small to rather small (13μm - 29μm), panporate, exine psilate.

1990 - 91 Survey :	Total number of pollen grains : 1103
Site A	Period of occurrence : Throughout the year
	Maximum occurrence : Feb (296)

TABLE : 3 MONTHLY TOTALS OF AIRBORNE POLLEN GRAINS DURING 1990-1991

PLANT NAME	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTAL	PERCENTAGE
1. ACACIA NILOTICA	17	1	-	-	-	-	-	-	-	1	6	17	42	0.10
2. AEGLE MARMELOS	-	-	-	-	-	-	-	-	65	28	1	-	94	0.23
3. AILANTHUS EXCELSA	-	-	-	-	1	373	21	1	3	1	-	-	400	0.98
4. ALNUS SP.	-	22	9	1	1	-	-	-	-	1	2	-	36	0.09
5. ALTERNANTHERA SESSILIS	1	2	-	-	-	1	-	1	1	-	-	1	7	0.02
6. AMARANTHACEAE/CHENOPODIACEAE	134	118	54	40	31	296	210	98	69	3	9	41	1103	2.77
7. OTHER APIACEAE	-	-	-	-	-	3	16	3	-	-	-	-	22	0.05
8. ARGEMONE MEXICANA	-	-	-	-	-	-	4	4	-	-	-	-	8	0.02
9. ARACEAE	-	-	-	-	-	-	2	9	14	-	-	-	25	0.06
10. ARTEMISIA SP.	30	65	10	-	-	-	-	-	-	-	-	-	105	0.26
11. OTHER ASTERACEAE	3	2	7	2	6	12	26	4	21	2	1	-	86	0.21
12. AZADIRACHTA INDICA	-	-	-	-	-	-	7	750	109	2	-	-	868	2.12
13. BARRINGTONIA ACUTANGULA	-	-	-	-	-	-	3	5	17	2	5	2	34	0.08
14. BAUHINIA PURPUREA	-	-	-	-	-	-	1	-	-	-	-	-	1	0.002
15. BORASSUS FLABELLIFER	-	-	-	-	-	-	-	-	-	-	4	-	4	0.01
16. BOMBAX CEIBA	-	-	-	-	-	8	1	-	3	-	-	-	12	0.03
17. BOUGAINVILLEA SP.	-	-	-	2	-	-	-	-	-	-	-	-	2	0.004
18. BRASSICA SP.	-	-	-	4	39	511	16	20	6	-	-	-	985	2.41
19. CAJANAS CAJAN	-	-	-	-	-	-	2	-	-	-	-	-	2	0.004
20. CALLISTEMON CITRINUS	8	11	55	159	30	17	22	53	5	2	1	1	384	0.94
21. CANNABIS SATIVA	1	-	-	1	-	31	14	21	19	1	2	-	32	0.15
22. CARYOTA URENS	-	-	-	-	270	562	1	146	-	23	-	-	1002	2.45
23. CASSIA SPP.	31	26	12	7	1	2	1	-	5	-	2	1	88	0.22
24. CASUARINA EQUISETIFOLIA	-	-	-	-	-	-	7	-	-	-	-	-	7	0.02
25. CELOSIA CRISTATA	-	-	-	1	-	-	4	4	-	-	-	-	9	0.02
26. COLEUS SP.	-	-	1	4	-	-	-	-	-	-	-	-	5	0.012
27. CONVOLVULUS PROSTATUS	-	-	-	-	-	-	1	1	-	-	-	-	2	0.005
28. CORIANDRUM SATIVUM	-	-	-	-	1	33	28	4	2	-	-	-	68	0.170
29. CORONOPUS DIDYNAMUS	-	-	-	-	-	22	-	-	-	-	-	-	22	0.050
30. CROTON BONPLANDIANUM	-	-	-	-	-	2	3	6	4	-	4	2	21	0.050
31. CYPERACEAE	32	10	1	2	-	2	5	-	14	14	16	59	145	0.350
32. DELONIX REGIA	-	-	-	-	-	-	2	6	37	-	-	-	45	0.110
33. DIANTHUS SP.	-	-	-	-	-	-	1	-	-	-	-	-	1	0.002

PLANT NAME	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTAL	PERCENTAGE
34. DRYPETES ROXBURGHII	-	-	-	1	2	790	302	341	12	-	-	-	1448	3.540
35. EMBLICA OFFICINALIS	-	-	-	-	-	-	40	41	3	-	-	-	84	0.210
36. EPHEDRA FOLIATA	-	-	-	-	-	28	17	42	-	5	6	-	98	0.240
37. EUCALYPTUS SP.	-	7	2	5	6	89	17	4	-	-	-	-	130	0.320
38. FERONIA LIMONIA	-	-	-	-	-	-	-	8	-	-	-	-	8	0.020
39. GNAPHALIUM SP.	-	-	-	-	-	14	1	-	-	-	-	-	15	0.040
40. GOMPHRENA GLOBOSA	-	2	-	-	-	-	-	-	-	-	-	-	2	0.005
41. HOLOPTELEA INTEGRIFOLIA	-	-	-	-	3	7994	808	108	20	-	-	-	8933	21.900
42. IBERIS AMARA	-	-	-	-	6	149	5	-	-	-	-	-	160	0.390
43. IMPATIENS BALSAMINA	1	8	7	-	-	-	-	-	-	-	-	-	16	0.040
44. JUSTICIA SP.	-	-	-	1	-	32	6	-	-	-	-	-	39	0.090
45. LATHYRUS ODORATUS	-	-	-	-	-	3	-	-	-	-	-	-	3	0.007
46. MADHUCA LONGIFOLIA	-	-	-	-	-	-	153	1451	85				1689	4.130
47. OTHER MALVACEAE	3	2	2	1	1	3	1	1	-	2	-		16	0.040
48. MANGIFERA INDICA	-	-	-	-	-	-	-	25	-	-	-	-	25	0.060
49. MILLETIA PEGUENSIS	-	-	-	-	-	13	4	9	3	-	-	-	29	0.070
50. MIRABILIS JALAPA	-	-	-	-	-	-	1	-	-	-	-	-	1	0.002
51. OTHER MONOCOTYLEDONS	37	5	26	27	40	146	305	126	48	19	43	58	880	2.150
52. MORUS ALBA	1	3	-	-	3	129	23	44	15	8	3	-	229	0.560
53. MURRAYA KOENIGII	-	-	-	-	-	-	5	23	3	-	-	-	31	0.080
54. PARKINSONIA ACULEATA	-	-	-	-	-	-	-	1	-	-	-	-	1	0.002
55. PARTHENIUM HYSTEROPHORUS	41	81	38	15	5	200	88	94	170	48	36	26	842	2.060
56. PELTOPHORUM PTEROCARPUM	12	-	-	-	-	-	-	-	-	-	-	-	12	0.030
57. PHLOX DRUMMONDII	-	-	-	-	-	-	5	-	-	-	-	-	5	0.012
58. PHOENIX SYLVESTRIS					-	84	92	15	4	-	-	-	195	0.480
59. PINUS ROXBURGHII	-	7	-	2	6	2217	252	183	9	7	7	-	2690	6.580
60. PITHECELOBIUM DULCE	-	-	-	-	-	2	2	-	-	-	-	-	4	0.010
61. POACEAE	1989	5161	530	225	95	401	450	601	248	101	129	426	10356	25.340
62. POLYALTHIA LONGIFOLIA	-	-	-	-	-	-	1	622	29	-	-	-	652	1.600
63. POLYGONUM PLEBEIUM	-	-	-	-	-	1	1	17	35	-	-	-	54	0.130
64. PONGAMIA PINNATA	-	-	-	-	-	-	14	898	80	-	-	-	992	2.430
65. PORTULACA SP.	-	-	-	-	-	-	-	2	-	-	-	-	2	0.005
66. PROSOPIS JULIFLORA	-	-	-	-	-	1	2	45	5	-	-	-	72	0.180

PLANT NAME	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTAL	PERCENTAGE
67. PTEROSPERMUM ACERIFOLIUM	-	-	-	-	-	-	21	2	-	-	-	-	23	0.060
68. RICINUS COMMUNIS	2	23	96	476	700	1037	99	10	-	-	-	-	2443	5.980
69. RORIPPA DUBIA	-	-	-	2	2	1	-	-	-	-	-	-	5	0.012
70. ROYSTONEA REGIA	-	-	-	4	220	31	-	-	-	-	-	-	255	0.620
71. RUMEX DENTATUS	-	-	-	2	1	16	12	1	2	-	-	-	34	0.080
72. OTHER RUTACEAE	-	-	-	15	1	-	-	-	-	-	-	-	16	0.040
73. SAMANEA SAMAN	-	-	-	-	-	1	5	10	-	-	-	-	16	0.040
74. SANTALUM ALBUM		5	-		-		-			-	-		5	0.012
75. SPATHODIA SP.	-	-	-	-	-	-	-	6	1	-	-	-	7	0.020
76. SPERGULA FALLAX	-	-	-	-	-	-	-	5	-	-	-	-	5	0.012
77. SYZYGIUM CUMINI	-	-	-	-	-	-	-	1	95	-		-	96	0.230
78. TAMARINDUS INDICA	-	-	-	-	-	-	-	-	-	2	-	-	2	0.005
79. TERMINALIA ARJUNA	-	-	-	-	-	-	7	9	2	-	-	-	18	0.040
80. THUJA/ CUPRESSUS	-	-	-	-	-	3	-	4	-	-	1	-	8	0.020
81. TINOSPORA CORDIFOLIA	13	1	-	-	-	9	6	4	1	1	2	26	63	0.150
82. TOONA CILIATA	-	-	-	-	-	166	8	-	-	-	-	-	174	0.430
83. TYPHA AUSTRALIS	-	-	-	-	-	-	162	368	150	8	41	15	744	1.820
84. URTICACEAE / MORACEAE	-	-	-	-	-	2	1	-	10	10	-	2	25	0.060
85. XANTHIUM STRUMERIUM	3	20	6	-	-	-	-	3	28	-	-	2	62	0.150
86. UNDETERMINED	289	100	174	48	85	145	70	73	328	39	39	61	1451	3.550
87. GRAND TOTAL	2684	5682	1030	1084	1908	15554	3423	6333	1770	330	360	740	40862	

Minimum occurrence : Jun (3)

Percentage contribution : 2.77

1991 - 92 Survey :	Total number of pollen grains : 433
Site A	Period of occurrence : Throughout the year
	Maximum occurrence : Mar (73)
	Minimum occurrence : Jun (11)
	Percentage contribution : 5.11

1991 - 92 Survey :	Total number of pollen grains : 39
Site B	Period of occurrence : Throughout the year
	Maximum occurrence : Oct.(84)
	Minimum occurrence : Jun (2)
	Percentage contribution : 5.29

1991 Survey :	Total number of pollen grains : 1376 m^{-3}
Site A	Period of occurrence : Throughout the year
	Maximum occurrence : Mar (248m^{-3})
	Minimum occurrence : Jun (21 m^{-3})
	Percentage contribution : 4.29

ANACARDIACEAE

Mangifera indica L. (Pl.2, Fig.11) Grains prolate, spheroidal, size small (23.5 X 21μm), amb triangular with convex sides, 3-zonicolporate, angulaperturate, exine finely reticulate.

1990 - 91 Survey :	Total number of pollen grains : 25
Site A	Period of occurrence : Apr
	Maximum occurrence : Apr (25)
	Minimum occurrence : Apr (25)
	Percentage contribution : 0.06

ANNONACEAE

Polyalthia longifolia (Sonner.) (Pl.2, Fig.10) Grains spheroidal, size medium, (31 μm), amb circular, inaperturate, exine spinulose.

1990 - 91 Survey :	Total number of pollen grains : 652
Site A	Period of occurrence : Mar, Apr, May
	Maximum occurrence : Apr (622)
	Minimum occurrence : Mar (1)
	Percentage contribution : 25.34

1991 - 92 Survey :	Total number of pollen grains : 41
Site A	Period of occurrence : Apr, Jun

Maximum occurrence : Apr (2)

Minimum occurrence : Jun (1)

Percentage contribution : 0.04

1991 Survey : Total number of pollen grains : 92 m^{-3}

Site A Period of occurrence : Mar - May

Maximum occurrence : Apr (43 m^{-3})

Minimum occurrence : Mar (14 m^{-3})

Percentage contribution : 0.28

APIACEAE

Coriandrum sativum L. (Pl.2, Fig.8) Grains perprolate , size rather small, (33 X 13 µm), amb circular, 3 zonicolporate, exine foveolate.

1990 - 91 Survey : Total number of pollen grains : 68

Site A Period of occurrence : Jan, Feb, Mar, Apr, May

Maximum occurrence : Feb (33)

Minimum occurrence : Jan (1)

Percentage contribution : 0.17

1991 - 92 Survey : Total number of pollen grains : 56

Site A Period of occurrence : Jan - May

Maximum occurrence : Jan (41)

Minimum occurrence : Apr, May (1)

Percentage contribution : 0.66

1991 - 92 Survey : Total number of pollen grains : 26

Site B Period of occurrence : Dec - Apr

Maximum occurrence : Mar (11)

Minimum occurrence : Jan, Apr (2)

Percentage contribution : 0.33

1991 Survey : Total number of pollen grains : 168 m^{-3}

Site A Period of occurrence : Dec - Aug

Maximum occurrence : Feb, Mar (35m^{-3})

Minimum occurrence : May, Jul, Aug (7 m^{-3})

Percentage contribution : 0.52

ASTERACEAE

Artemisia sp. L. (Pl.2, Fig.12) Grains oblate spheroidal, size small (18 X 20 μm), amb triangular, 3 - zonicolporate, , angulaperurate, exine granulose.

1990 - 91 Survey : Total number of pollen grains : 105

Site A Period of occurrence : Sep, Oct, Nov

Maximum occurrence : Oct (65)

Minimum occurrence : Nov (10)

Percentage contribution : 0.26

1991 - 92 Survey :	Total number of pollen grains : 62
Site A	Period of occurrence : Jul, Sept - Dec
	Maximum occurrence : Oct (43)
	Minimum occurrence : Jul, Dec (2)
	Percentage contribution : 0.73

1991 - 92 Survey :	Total number of pollen grains : 72
Site B	Period of occurrence : May, Jun, Sept - Nov
	Maximum occurrence : Oct (39)
	Minimum occurrence : Jun (1)
	Percentage contribution : 0.90

1991 Survey :	Total number of pollen grains : 135 m^{-3}
Site A	Period of occurrence : Jul - Oct
	Maximum occurrence : Sep (71 m^{-3})
	Minimum occurrence : Jul (7 m^{-3})
	Percentage contribution : 0.42

Gnaphalium sp. L. (Pl.2, Fig.13) Grains suboblate, size small, (12.5 X 15 μm), amb subtriangular, 3 - zonicolporate, angulaperturate, exine spinose.

1990 - 91 Survey :	Total number of pollen grains : 15
Site A	Period of occurrence : Feb, Mar
	Maximum occurrence : Feb (14)
	Minimum occurrence : Mar (1)
	Percentage contribution : 0.04
1991 - 92 Survey :	Total number of pollen grains : 1
Site A	Period of occurrence : Mar
	Maximum occurrence : Mar (1)
	Minimum occurrence : Mar (1)
	Percentage contribution : 0.01
1991 - 92 Survey :	Total number of pollen grains : 8
Site B	Period of occurrence : Feb, Mar, Jul
	Maximum occurrence : Mar (5)
	Minimum occurrence : Jul (1)
	Percentage contribution : 0.10
1991 Survey :	Total number of pollen grains : 28 m^{-3}
Site A	Period of occurrence : Feb, Mar
	Maximum occurrence : Feb (21 m^{-3})
	Minimum occurrence : Mar (7 m^{-3})

Percentage contribution : 0.09

Parthenium hysterophorus L. (Pl.3, Fig.14) Grains oblate, spheroidal, size small, (18 X 19 μm), amb triangular, 3 zonicolporate, angulaperturate, exine spinose.

1990 - 91 Survey :	Total number of pollen grains : 842
Site A	Period of occurrence : Throughout the year
	Maximum occurrence : Feb (200)
	Minimum occurrence : Jan (5)
	Percentage contribution : 2.06

1991 - 92 Survey :	Total number of pollen grains : 250
Site A	Period of occurrence : Mar - Jan
	Maximum occurrence : Apr (30)
	Minimum occurrence : Jan (2)
	Percentage contribution : 2.95

1991 - 92 Survey :	Total number of pollen grains : 415
Site B	Period of occurrence : Throughout the year
	Maximum occurrence : Jul (74)
	Minimum occurrence : Sep (12)
	Percentage contribution : 5.20

1991 Survey :	Total number of pollen grains : 415 m^{-3}
Site A	Period of occurrence : Feb - Oct, Dec
	Maximum occurrence : Jun (128 m^{-3})
	Minimum occurrence : Dec (7 m^{-3})
	Percentage contribution : 1.17

Xanthium strumerium L. (Pl.3, Fig.18) Grains oblate spheroidal, small (22 X 23 µm), amb circular, 3 zonicolpoidorate, circulaperturate exine spinulose.

1990 - 91 Survey :	Total number of pollen grains : 62
Site A	Period of occurrence : Aug - Nov, Apr, May
	Maximum occurrence : May (28)
	Minimum occurrence : Aug (2)
	Percentage contribution : 0.15

1991 - 92 Survey :	Total number of pollen grains : 41
Site A	Period of occurrence : May, Jun, Sep - Nov
	Maximum occurrence : Oct (19)
	Minimum occurrence : Jun (1)
	Percentage contribution : 0.48

1991 - 92 Survey : Total number of pollen grains : 37

Site B Period of occurrence : Sept - Dec, Apr - Jun

Maximum occurrence : Oct (26)

Minimum occurrence : Nov, Dec (1)

Percentage contribution : 0.46

1991 Survey : Total number of pollen grains : 56 m^{-3}

Site A Period of occurrence : Apr, Jul, Aug, Oct

Maximum occurrence : Aug (28 m^{-3})

Minimum occurrence : Jul, Oct (7 m^{-3})

Percentage contribution : 0.17

BALSAMINACEAE

Impatiens balsamina L. (Pl.3, Fig.19) Grains bilateral, size medium (22 X 32 μm), amb rectangular, 4 zonicolpoidate, colpi faint, angulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains : 16

Site A Period of occurrence : Sep - Nov

Maximum occurrence : Oct (8)

Minimum occurrence : Sep (1)

Percentage contribution : 0.04

1991 Survey : Total number of pollen grains : 7 m^{-3}

Site A Period of occurrence : Jan

Maximum occurrence : Jan (7 m^{-3})

Minimum occurrence : Jan (7 m^{-3})

Percentage contribution : 0.02

BETULACEAE

***Alnus* sp.** Mill . (Pl.3, Fig.20) Grains sub-oblate, size small (18 X 22 µm), amb quadrangular or pentagonal , 4-5 zoniporate, angulaperturate, aspidote, exine psilate.

1990 - 91 Survey : Total number of pollen grains : 36

Site A Period of occurrence : Oct - Jan, Jun, Jul

Maximum occurrence : Oct (22)

Minimum occurrence : Dec, Jan, Jun (1)

Percentage contribution : 0.09

1991 - 92 Survey : Total number of pollen grains : 33

Site A Period of occurrence : May, Oct - Feb

Maximum occurrence : Nov (13)

Minimum occurrence : Dec, Jan (1)

Percentage contribution : 0.39

1991 - 92 Survey :	Total number of pollen grains : 45
Site B	Period of occurrence : Oct - Mar
	Maximum occurrence : Mar (16)
	Minimum occurrence : Jan (1)
	Percentage contribution : 0.56

1991 Survey :	Total number of pollen grains : 91 m^{-3}
Site A	Period of occurrence : Jul, Oct, Dec-Feb
	Maximum occurrence : Feb, Oct (28 m^{-3})
	Minimum occurrence : Jan, Jul (7 m^{-3})
	Percentage contribution : 0.28

BIGNONIACEAE

***Spathodea* sp.** Beauv. (Pl.3, Fig.21) Grains prolate, size rather large (45 X 33 µm), amb circular, 3 zonicolpate, circulaperturate, exine retipilate.

1990-91 Survey :	Total number of pollen grains :7
Site A	Period of occurrence : Apr, May
	Maximum occurrence : Apr (6)
	Minimum occurrence : May (1)
	Percentage contribution : 0.02

1991 - 92 Survey : Total number of pollen grains : 2

Site A Period of occurrence : Mar, May

Maximum occurrence : Mar, May (1)

Minimum occurrence : Mar, May (1)

Percentage contribution : 0.02

1991 Survey : Total number of pollen grains : 7 m^{-3}

Site A Period of occurrence : Feb

Maximum occurrence : Feb (7m^{-3})

Minimum occurrence : Feb (7 m^{-3})

Percentage contribution : 0.02

BOMBACACEAE

Bombax ceiba L. (Pl.3, Fig.22, 23) Grains oblate, size large (30 - 53 µm), amb triangular, 3 - zonicolpate, planaperturate, exine reticulate.

1991 Survey : Total number of pollen grains :12

Site A Period of occurrence : Feb, Mar, May

Maximum occurrence : Feb (8)

Minimum occurrence : Mar (1)

Percentage contribution : 0.03

1991 - 92 Survey : Total number of pollen grains : 2

Site A Period of occurrence : Feb

Maximum occurrence : Feb (4)

Minimum occurrence : Feb (4)

Percentage contribution : 0.05

1991 - 92 Survey : Total number of pollen grains : 1

Site B Period of occurrence : Mar

Maximum occurrence : Mar (1)

Minimum occurrence : Mar (1)

Percentage contribution : 0.012

1991 Survey : Total number of pollen grains : 21 m^{-3}

Site A Period of occurrence : Feb, Apr

Maximum occurrence : Apr (14 m^{-3})

Minimum occurrence : Feb (7 m^{-3})

Percentage contribution : 0.07

BRASSICACEAE

***Brassica* sp.** L. (Pl.3, Figs.24, 25) Grains prolate spheroidal, size rather small (30 X 26 µm), amb almost circular, 3 zonicolpate, , circulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :958

Site A Period of occurrence : Dec - May

Maximum occurrence : Feb (511)

Minimum occurrence : May (6)

Percentage contribution : 2.41

1991 - 92 Survey :	Total number of pollen grains : 158
Site A	Period of occurrence : Nov - Jul, Sept
	Maximum occurrence : Jan (49)
	Minimum occurrence : Jun (1)
	Percentage contribution : 0.05

1991 - 92 Survey :	Total number of pollen grains : 214
Site B	Period of occurrence : Nov - Apr
	Maximum occurrence : Jan (87)
	Minimum occurrence : Apr (5)
	Percentage contribution : 2.68

1991 Survey :	Total number of pollen grains : 432 m^{-3}
Site A	Period of occurrence : Nov-Apr, Jun, Jul
	Maximum occurrence : Jan (213 m^{-3})
	Minimum occurrence : Jun, Jul, Nov (7 m^{-3})
	Percentage contribution : 1.35

Coronopus didynamus (Linn) Sm (Pl.4 Figs.26, 27) Grains prolate spheroidal , size small (19.3 X 18.6 μm), amb subtriangular, 3 zonicolpate, slightly fossaperturate, exine reticulate.

1990 - 91 Survey :	Total number of pollen grains :22
Site A	Period of occurrence : Feb
	Maximum occurrence : Feb (22)
	Minimum occurrence : Feb (22)
	Percentage contribution : 0.054

1991 - 92 Survey :	Total number of pollen grains : 9
Site A	Period of occurrence : Jan
	Maximum occurrence : Jan (9)
	Minimum occurrence : Jan (9)
	Percentage contribution : 0.10

1991 - 92 Survey :	Total number of pollen grains : 11
Site B	Period of occurrence : Jan
	Maximum occurrence : Jan (11)
	Minimum occurrence : Jan (11)
	Percentage contribution : 0.14

1991 Survey :	Total number of pollen grains : 7 m^{-3}

Site A Period of occurrence : Mar

Maximum occurrence : Mar (7 m^{-3})

Minimum occurrence : MAr (7 m^{-3})

Percentage contribution : 0.02

Iberis amara L. (Pl.4, Fig.28) Grains oblate spheroidal, size rather small (24 X 25 µm), amb circular, 3 zonicolpate, circulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :160

Site A Period of occurrence : Jan - Mar

Maximum occurrence : Feb (149)

Minimum occurrence : Mar (5)

Percentage contribution : 0.39

1991 - 92 Survey : Total number of pollen grains : 12

Site A Period of occurrence : Dec - Feb, Apr

Maximum occurrence : Apr (5)

Minimum occurrence : Dec (1)

Percentage contribution : 0.14

1991 - 92 Survey : Total number of pollen grains : 7

Site B Period of occurrence : Jan

Maximum occurrence : Jan (7)

Minimum occurrence : Jan (7)

Percentage contribution : 0.09

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ALLAHABAD

1991 Survey :	Total number of pollen grains : 85 m^{-3}
Site A	Period of occurrence : Jan -Mar
	Maximum occurrence : Feb (43 m^{-3})
	Minimum occurrence : Jan (7 m^{-3})
	Percentage contribution : 0.26

Rorippa dubia (Pers.) Hara. (Pl.4, Fig.29, 30) Grains spheroidal, size small, 20 µm, amb, circular, 3 zonicolpate, circulaperturate, exine reticulate.

1991 Survey :	Total number of pollen grains : 5
Site A	Period of occurrence : Dec - Feb
	Maximum occurrence : Dec, Jan (2)
	Minimum occurrence : Feb (1)
	Percentage contribution : 0.012

1991 - 92 Survey :	Total number of pollen grains : 3
Site A	Period of occurrence : Dec, Jan
	Maximum occurrence : Dec (2)
	Minimum occurrence : Jan (1)
	Percentage contribution : 0.04

1991 - 92 Survey : Total number of pollen grains : 9

Site B Period of occurrence : Dec - Mar

Maximum occurrence : Dec (6)

Minimum occurrence : Jan, Feb, Mar (1)

Percentage contribution : 0.11

1991 Survey : Total number of pollen grains : 71 m^{-3}

Site A Period of occurrence : Jan - Mar

Maximum occurrence : Jan (50 m^{-3})

Minimum occurrence : Jan (7 m^{-3})

Percentage contribution : 0.22

CANNABINACEAE

Cannabis sativa L. (Pl.4, Fig.31) Grains subobblate, size small (18 X 23 µm),amb circular, 3 - zoniporate, angulaperturate, exine psilate.

1990 - 91 Survey : Total number of pollen grains :62

Site A Period of occurrence : Sep, Dec, Feb - Jul

Maximum occurrence : Apr (21)

Minimum occurrence : Sept, Dec, Jun (1)

Percentage contribution : 0.15

1991 - 92 Survey : Total number of pollen grains : 28

Site A Period of occurrence : Mar - Jun, Aug - Oct

Maximum occurrence : Mar, May (9)

Minimum occurrence : Sep (1)

Percentage contribution : 0.33

1991 - 92 Survey : Total number of pollen grains : 19

Site B Period of occurrence : Mar - May, Oct, Nov

Maximum occurrence : May (10)

Minimum occurrence : Oct, Nov (1)

Percentage contribution : 0.23

1991 Survey : Total number of pollen grains : 49 m^{-3}

Site A Period of occurrence : Mar-Jun, Sep, Oct

Maximum occurrence : Apr (14 m^{-3})

Minimum occurrence : Mar, May, Jun, Sep, Oct (7 m^{-3})

Percentage contribution : 0.15

CARYOPHYLLACEAE

Dianthus **sp.** L. (Pl.4, Fig.33) Grains spheroidal, size rather small, (30 µm), amb circular, panporate, pore membrane baset with small spinules, exine thick, punctitegillate, with small spinules.

1990 - 91 Survey : Total number of pollen grains :1

Site A Period of occurrence : Mar

Maximum occurrence : Mar (1)

Minimum occurrence : Mar (1)

Percentage contribution : 0.002

1991 - 92 Survey : Total number of pollen grains : 1

Site B Period of occurrence : Jan

Maximum occurrence : Jan (1)

Minimum occurrence : Jan (1)

Percentage contribution : 0.012

1991 Survey : Total number of pollen grains : 7 m^{-3}

Site A Period of occurrence : Jan

Maximum occurrence : Jan (7 m^{-3})

Minimum occurrence : Jan (7 m^{-3})

Percentage contribution : 0.02

Spergula fallax (Lowe) E. H. L. Krause (Pl.4, Fig.32) Grains suboblate, size small (20 X 24 μm) amb circular, 3 zonicolpate, circulaperturate, aperture membrane partly granulose, exine coarsely granular.

1990 - 91 Survey : Total number of pollen grains :5

Site A Period of occurrence : Apr

Maximum occurrence : Apr (5)

Minimum occurrence : Apr (5)

Percentage contribution : 0.01

CASUARINACEAE

Casuarina equisetifolia J. R. & G. Forster (Pl.4, Fig.35) Grains oblate spheroidal, size rather small (25 X 27 μm), amb triangular with convex sides, 3 zoniporate, angular aperturate, exine psilate.

1990 - 91 Survey : Total number of pollen grains : 7

Site A Period of occurrence : Mar

Maximum occurrence : Mar (7)

Minimum occurrence : Mar (7)

Percentage contribution : 0.02

1991 - 92 Survey : Total number of pollen grains : 14

Site A Period of occurrence : Jan, Feb, Apr

Maximum occurrence : Feb (10)

Minimum occurrence : Jan, Apr (2)

Percentage contribution : 0.17

1991 - 92 Survey : Total number of pollen grains : 3

Site B Period of occurrence : Feb

Maximum occurrence : Feb (3)

Minimum occurrence : Feb (3)

Percentage contribution : 0.04

1991 Survey : Total number of pollen grains : 64 m^{-3}

Site A Period of occurrence : Feb, Mar

Maximum occurrence : Mar (50 m^{-3})

Minimum occurrence : Feb (14 m^{-3})

Percentage contribution : 0.19

COMBRETACEAE

Terminalia arjuna (Roxb. ex D. C.) Weight & Arnott. (Pl.4, Fig.36)

Grains ± spheroidal, size small (13 X 14 µm), amb ± circular, 3 zonicolporate, colpi alternating with 3 psendocolpi, angulaperturate, exine psilate.

1990 - 91 Survey : Total number of pollen grains :18

Site A Period of occurrence : Mar - May

Maximum occurrence : Apr (9)

Minimum occurrence : May (2)

Percentage contribution : 0.04

1991 - 92 Survey :	Total number of pollen grains : 2
Site A	Period of occurrence : Feb
	Maximum occurrence : Feb (2)
	Minimum occurrence : Feb (2)
	Percentage contribution : 0.02

1991 - 92 Survey :	Total number of pollen grains : 1
Site B	Period of occurrence : Jun
	Maximum occurrence : Jun (1)
	Minimum occurrence : Jun (1)
	Percentage contribution : 0.012

1991 Survey :	Total number of pollen grains : 14 mm^{-3}
Site A	Period of occurrence : JAn, Mar
	Maximum occurrence : Jan, Mar (7 m^{-3})
	Minimum occurrence : Jan, Mar (7 m^{-3})
	Percentage contribution : 0.04

CONVOLVULACEAE

Convolulus prostatus. Forssk. (Pl.4, Fig.37) Grains subprolate, size large (71 x 59 μm) amb circular, 3 zonicolpate, circulaperturate, aperture membrane crustate, exine foveolate.

1991 Survey : Total number of pollen grains :2

Site A Period of occurrence : Mar, Apr

Maximum occurrence : Mar, Apr (1)

Minimum occurrence : Mar, Apr (1)

Percentage contribution : 0.005

EUPHORBIACEAE

Croton bonplandianum Baill (Pl.4, Fig.40) Grains spheroidal, size rather large (45 μm), amb circular, inaperturate, exine baculate.

1990 - 91 Survey : Total number of pollen grains :21

Site A Period of occurrence : Feb - May, Jul, Aug

Maximum occurrence : Apr (6)

Minimum occurrence : Feb, Aug (2)

Percentage contribution : 0.05

1991 - 92 Survey : Total number of pollen grains : 2

Site A Period of occurrence : Aug, Sept

Maximum occurrence : Aug, Sept (1)

Minimum occurrence : Aug, Sept (1)

Percentage contribution : 0.02

1991 - 92 Survey : Total number of pollen grains : 22

Site B Period of occurrence : Aug - Oct, Apr

Maximum occurrence : Aug (9)

Minimum occurrence : Apr (2)

Percentage contribution : 0.28

Drypetes roxburghii (Wall.) Harusava.. (Pl.4, Fig.34) Grains oblate spheroidal, size medium (28 X 30 μm), amb circular, 3 zonicolporate, circulaperturate, exine reticulate.

1990 -91 Survey : Total number of pollen grains :1448

Site A Period of occurrence : Dec - May

Maximum occurrence : Feb (790)

Minimum occurrence : Dec (1)

Percentage contribution : 3.54

1991 - 92 Survey : Total number of pollen grains : 82

Site A Period of occurrence : Jan - Jun

Maximum occurrence : Apr (32)

Minimum occurrence : Jan, May (1)

Percentage contribution : 0.97

1991 - 92 Survey : Total number of pollen grains : 46

Site B Period of occurrence : Feb - May

Maximum occurrence : Mar (36)

Minimum occurrence : Feb (2)

Percentage contribution : 0.58

1991 Survey : Total number of pollen grains : 149 m^{-3}

Site A Period of occurrence : Feb - July

Maximum occurrence : Mar (71 m^{-3})

Minimum occurrence : Apr, May, Jul (7 m^{-3})

Percentage contribution : 0.47

Emblica officinalis Gaertn. (Pl.4, Fig.39) Grains oblate spheroidal, size small (18 X 19 µm), amb circular, 4-5 zonicolporate, circulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :84

Site A Period of occurrence : Mar - May

Maximum occurrence : Apr (41)

Minimum occurrence : May (3)

Percentage contribution : 0.21

1991 - 92 Survey : Total number of pollen grains : 17

Site A Period of occurrence : Mar, Apr, Jun, Jul

Maximum occurrence : Apr (9)

Minimum occurrence : Jun (1)

Percentage contribution : 0.20

1991 - 92 Survey : Total number of pollen grains : 3

Site B Period of occurrence : Apr

Maximum occurrence : Apr (3)

Minimum occurrence : Apr (3)

Percentage contribution : 0.04

1991 Survey : Total number of pollen grains : 42 m^{-3}

Site A Period of occurrence : Mar, Apr, Jul

Maximum occurrence : Mar (21 m^{-3})

Minimum occurrence : Apr (7 m^{-3})

Percentage contribution : 0.13

Ricinus communis L. (Pl.4, Fig.38) Grains oblate spheroidal, size rather small (27 X 31 µm), amb triangular, 3 zonicolporate, angulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :2443

Site A Period of occurrence : Sep - Apr

Maximum occurrence : Feb (1037)

Minimum occurrence : Sept (2)

Percentage contribution : 5.98

1991 - 92 Survey :	Total number of pollen grains : 405
Site A	Period of occurrence : Sept - Apr
	Maximum occurrence : Feb (156)
	Minimum occurrence : Sept (1)
	Percentage contribution : 4.78

1991 - 92 Survey :	Total number of pollen grains : 523
Site B	Period of occurrence : Sept - May
	Maximum occurrence : Feb (142)
	Minimum occurrence : May (1)
	Percentage contribution : 6.55

1991 Survey :	Total number of pollen grains :
Site A	Period of occurrence :
	Maximum occurrence :
	Minimum occurrence :
	Percentage contribution :

FABACEAE

Caesalpiniaceae

Bauhinia purpurea L. (Pl.4, Fig.41) Grains oblate, size large (63 X 46 μm), amb triangular,3 zonicolporate, angulaperturate, exine striate.

1990 - 91 Survey : Total number of pollen grains :1

Site A Period of occurrence : Mar

Maximum occurrence : Mar (1)

Minimum occurrence : Mar (1)

Percentage contribution : 0.002

***Cassia* spp.** L. (Pl.5, Fig.44, 45) Grain suboblate, size medium to rather large, amb subtriangular, 3 - zonicolporate, angulaperturate, exine psilate, granulose, finely reticulate.

1990 - 91 Survey : Total number of pollen grains :88

Site A Period of occurrence : Sep - Mar, May, Jul, Aug

Maximum occurrence : Sept (31)

Minimum occurrence : Jan, MAr, Aug - (1)

Percentage contribution : 0.22

1991 - 92 Survey : Total number of pollen grains : 41

Site A Period of occurrence : Oct - Dec, Feb, Apr, May, Aug

Maximum occurrence : Nov (20)

Minimum occurrence : Feb (1)

Percentage contribution : 0.48

1991 - 92 Survey : Total number of pollen grains : 23

Site B | Period of occurrence : Oct - Jan, Mar

Maximum occurrence : Oct (7)

Minimum occurrence : Jan (1)

Percentage contribution : 0.29

1991 Survey : Total number of pollen grains : 49

Site A Period of occurrence : Dec - Mar

Maximum occurrence : Feb (28 m^{-3})

Minimum occurrence : Fec, Jan, Mar (7 m^{-3})

Percentage contribution : 0.15

Delonix regia (Bojer ex. Hooker) (Pl.5, Fig.42, 43) Grains spheroidal, size large (53 X 56 μm) amb circular to subtriangular, 3-zonicolpate, circulaperturate, exine coarsely reticulate.

1990 - 91 Survey : Total number of pollen grains :45

Site A Period of occurrence : Mar - May

Maximum occurrence : May (37)

Minimum occurrence : Mar (2)

Percentage contribution : 0.11

1991 - 92 Survey : Total number of pollen grains : 65 Site B

Period of occurrence : Apr - Jun

Maximum occurrence : May (42)

Minimum occurrence : Jun (6)

Percentage contribution : 0.81

1991 Survey : Total number of pollen grains : 21 m^{-3}

Site A Period of occurrence : Apr, May

Maximum occurrence : May (14 m^{-3})

Minimum occurrence : Apr (7 m^{-3})

Percentage contribution : 0.07

Parkinsonia aculeata L. (Pl.5, Fig.46) Grains prolate spheroidal, size medium (35 X 32 μm), amb triangular with convex sides, 3 zonicolporate, planaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains : 1

Site A Period of occurrence : Apr

Maximum occurrence : Apr (1)

Minimum occurrence : Apr (1)

Percentage contribution : 0.002

Peltophorum pterocarpum (D.C.) Baker ex. Heyne (Pl.5, Fig.47) Grains sub-prolate, size large (93 X 85 μm), amb circular, 3 zonicolporate, circulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :12 Site A

Period of occurrence : Sept

Maximum occurrence : Sept (12)

Minimum occurrence : Sept (12)

Percentage contribution : 0.03

1991 - 92 Survey : Total number of pollen grains : 8

Site A Period of occurrence : Apr, Jul, Sept

Maximum occurrence : Jul (4)

Minimum occurrence : Apr (1)

Percentage contribution : 0.09

Tamarindus indica L. (Pl.9, Fig.93) Grains spheroidal, size rather small (28 X 29 μm), amb circular, 3 zonicolporate, circulaperturate, exine rugulate.

1990 - 91 Survey : Total number of pollen grains :2

Site A Period of occurrence : Jun

Maximum occurrence : Jun (2)

Minimum occurrence : Jun (2)

Percentage contribution : 0.005

1991 - 92 Survey : Total number of pollen grains : 1

Site B Period of occurrence : Jun

Maximum occurrence : Jun (1)

Minimum occurrence : Jun (1)

Percentage contribution : 0.012

Mimosaceae

Acacia nilotica (L) Delile (Pl.6, Fig.48) Polyads rectangular with round angular square size medium (35 X 38 μm) 16 celled central cells in two tiers of 4 cells each, rest 8 at the margin of the central tiers. Individual monad square, exine finely reticulate.

1990 - 91 Survey : Total number of pollen grains :42

Site A Period of occurrence : Sept, Oct, Jun - Aug

Maximum occurrence : Aug (17)

Minimum occurrence : Jun (1)

Percentage contribution : 0.103

1991 - 92 Survey : Total number of pollen grains : 12

Site A Period of occurrence : Jul - Oct,

Maximum occurrence : Sep (5)

Minimum occurrence : Jul (1)

Percentage contribution : 0.14

1991 - 92 Survey : Total number of pollen grains : 14

Site B Period of occurrence : Jul - Dec

Maximum occurrence : Aug, Sept, Oct (3)

Minimum occurrence : Dec (1)

Percentage contribution : 0.18

1991 Survey : Total number of pollen grains : 71 m^{-3}

Site A Period of occurrence : Jun, Aug-Sep, Nov

Maximum occurrence : Aug (43 m^{-3})

Minimum occurrence : Jun, Nov (7 m^{-3})

Percentage contribution : 0.22

Pithecelobium dulce (Roxb.) Benth. (Pl.6, Fig.49) Polyad spheroidal size large (71 X 67 μm), 16 celled, central eight cells in two tiers of 4 each, rest 8 at the margin of the central tiers, individual cells square to rectangular, 7-porate, exine coarsely granular.

1990 - 91 Survey : Total number of pollen grains :4

Site A Period of occurrence : Feb, Mar

Maximum occurrence : Feb, Mar (2)

Minimum occurrence : Feb, Mar (2)

Percentage contribution : 0.01

1991 Survey : Total number of pollen grains : 7 m^{-3}

Site A Period of occurrence : Mar

Maximum occurrence : Mar (7 m^{-3})

Minimum occurrence : Mar (7 m^{-3})

Percentage contribution : 0.02

Prosopis juliflora (Swartz.) D.C. (Pl.6, Fig.51) Gains subprolate, size medium (43 X 33 μm), amb circular, 3 zonicolporate, circulaperturate, exine finely reticulate.

1991 Survey : Total number of pollen grains :72

Site A Period of occurrence : Feb - May

Maximum occurrence : Apr (45)

Minimum occurrence : Feb (1)

Percentage contribution : 0.18

1991 - 92 Survey : Total number of pollen grains : 17

Site A Period of occurrence : Feb - May, Nov

Maximum occurrence : Apr (7)

Minimum occurrence : Feb (1)

Percentage contribution : 0.20

1991 - 92 Survey : Total number of pollen grains : 22

Site B | Period of occurrence : Mar, Apr, Nov

Maximum occurrence : Mar (19)

Minimum occurrence : Nov (1)

Percentage contribution : 0.28

1991 Survey : Total number of pollen grains : 85 m^{-3}

Site A | Period of occurrence : Jan, Apr

Maximum occurrence : Apr (64 m^{-3})

Minimum occurrence : jan (21 m^{-3})

Percentage contribution : 0.26

Samanea saman (Jacq.) Merr. (Pl.6, Fig.50) Polyad of size very large (106 X 87 µm), 22 - 24 cells, individual monad rectangular to triangualar, 5 porate, exine psilate.

1991 Survey : Total number of pollen grains :16

Site A | Period of occurrence : Feb - Apr

Maximum occurrence : Apr (10)

Minimum occurrence : Feb (1)

Percentage contribution : 0.04

1991 - 92 Survey : Total number of pollen grains : 1

Site A | Period of occurrence : Apr

Maximum occurrence : Apr (1)

Minimum occurrence : Apr (1)

Percentage contribution : 0.01

Papilionaceae

Cajanas cajan (L.) Millsp. (Pl.6, Fig.53) Grains oblate spheroidal, size rather large (39 X 43 μm), 3 zonicolporate, amb subtriangular, angulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :2

Site A Period of occurrence : Mar

Maximum occurrence : Mar (2)

Minimum occurrence : Mar (2)

Percentage contribution : 0.004

1991 - 92 Survey : Total number of pollen grains : 2

Site A Period of occurrence : Mar

Maximum occurrence : Mar (2)

Minimum occurrence : Mar (2)

Percentage contribution : 0.02

1991 Survey : Total number of pollen grains : 14 m^{-3}

Site A Period of occurrence : Jan, Apr

Maximum occurrence : Jan, Apr (14 m^{-3})

Minimum occurrence : Jan, Apr (14 m^{-3})

Percentage occurrence : 0.04

Lathyrus odoratus L. (Pl.6, Fig.56) Grains subprolate, size large (48 X 39 μm), amb circular, 3 zonicolporate, circulaperturate, exine tegillate.

1990 - 91 Survey : Total number of pollen grains :3

Site A

Period of occurrence : Feb

Maximum occurrence : Feb (3)

Minimum occurrence : Feb (3)

Percentage contribution : 0.007

1991 Survey : Total number of pollen grains : 14 m^{-3}

Site A

Period of occurrence : Jan, Feb

Maximum occurrence : Jan, Feb (7 m^{-3})

Minimum occurrence : Jan, Feb (7 m^{-3})

Percentage occurrence : 0.04

Milletia peguensis Ali. (Pl.6, Fig.54) Grain oblate spheroidal, size small (24 X 26 μm), amb triangular, 3 zonicolporate, angulaperturate, exine psilate.

1990 - 91 Survey : Total number of pollen grains :29

Site A Period of occurrence : Feb - May

Maximum occurrence : Feb (13)

Minimum occurrence : May (3)

Percentage contribution : 0.07

1991 - 92 Survey : Total number of pollen grains : 1

Site A Period of occurrence : Apr

Maximum occurrence : Apr (1)

Minimum occurrence : Apr (1)

Percentage contribution : 0.01

Pongamia pinnata (L) Pierre. (Pl.6, Fig.52) Grain oblate spheroidal, size small (24 X 36 μm), amb triangular, 3 zonicolporate, angulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :992

Site A Period of occurrence : Mar - May

Maximum occurrence : Apr (898)

Minimum occurrence : Mar (14)

Percentage contribution : 2.43

1991 - 92 Survey : Total number of pollen grains : 56

Site A Period of occurrence : Apr, May

Maximum occurrence : Apr (45)

Minimum occurrence : May (11)

Percentage contribution : 0.66

LAMIACEAE

***Coleus* sp.** Lour. (Pl.6, Fig.57) Grains sub-oblate, size medium (28 X 33 μm), amb slightly hexangular, 6 colpate, angulaperturate, exine granulose, collumellate, collumela forming indistinct reticulations at mesocolpia.

1990 - 91 Survey : Total number of pollen grains :53

Site A Period of occurrence : Nov, Dec

Maximum occurrence : Dec (3)

Minimum occurrence : Nov (1)

Percentage contribution : 0.012

Ocimum sanctum L. (Pl.6, Fig.55) Grain oblate spheroidal, size large (77 X 86 μm), amb circular, 6 - zonicolpate, circulaperturate, exine reticulate.

1991 Survey : Total number of pollen grains :7m $^{-3}$

Site A Period of occurrence : Feb

Maximum occurrence : Feb (7m^{-3})

Minimum occurrence : Feb (7m^{-3})

Percentage contribution : 0.02

TABLE : 4 MONTHLY TOTALS OF AIRBORNE POLLEN GRAINS PER CUBIC METER OF AIR DURING 1991 AT ALLAHABAD

PLANT NAME	JAN	FEB	MAR	APR	MAY*	JUN	JUL	AUG	SEP	OCT	NOV*	DEC	TOTAL	PERCEN-TAGE
1. ABUTILON INDICUM	-	-	-	-	-	-	-	-	-	-	-	7	7	0.02
2. ACACIA NILOTICA	-	-	-	-	-	7	-	43	14	-	7	-	71	0.22
3. OTHER ACANTHACEAE	50	21	21	-	-	-	-	-	14	7	-	-	113	0.35
4 AEGLE MARMELOS	-	-	7	14	7	35	7	-	7	-	-	-	77	0.24
5. AILANTHUS EXCELSA	43	21	64	43	-	7	7	-	-	-	-	-	185	0.56
6. ALNUS SP.	7	28	-	-	-	-	7	-	-	28	-	21	91	0.28
7. ALTERNANTHERA SESSILIS	-	-	-	-	-	-	-	7	7	-	-	-	14	0.04
8 AMARANTHACEAE/ CHENOPODIACEAE	128	128	248	142	14	21	35	206	206	135	14	106	1376	4.29
9. OTHER APIACEAE	7	-	-	-	-	-	-	-	-	-	-	-	7	0.02
10. OTHER ARECACEAE	-	21	206	149	57	156	78	21	7	-	-	-	695	2.17
11. ARTEMISIA SP.	-	-	-	-	-	-	7	14	71	43	-	-	135	0.41
12. OTHER ASTERACEAE	7	57	21	57	28	21	43	-	-	14	-	-	248	0.76
13. AZADIRACHTA INDICA	-	7	-	199	35	28	-	-	-	-	-	-	269	0.84
14. BARRINGTONIA ACUTANGULA	-	-	7	92	-	-	7	14	7	-	-	-	127	0.39
15. BOMBAX CEIBA	-	7	-	14	-	-	-	-	-	-	-	-	21	0.07
16. BORASSUS FLABELLIFER	-	-	-	7	-	-	7	-	-	-	-	-	14	0.04
17. BRASSICA SP.	213	78	57	28	-	7	7	-	-	-	7	35	432	1.35
18. CAJANAS CAJAN	7	-	-	7	-	-	-	-	-	-	-	-	14	0.04
19. CALLISTEMON CITRINUS	113	71	85	43	14	21	-	-	35	7	14	28	431	1.34
20. CANNABIS SATIVA	-	-	7	14	7	7	-	-	7	7	-	-	49	0.15
21. CARYOTA URENS	78	85	35	7	-	21	-	-	-	-	-	-	226	0.73
22. CASSIA SPP.	7	28	7	-	-	-	-	-	-	-	-	7	49	0.15
23. CASUARINA EQUISETIFOLIA	-	14	50	-	-	-	-	-	-	-	-	-	64	0.19
24. CELOSIA CRISTATA	-	-	-	-	-	-	-	-	-	7	-	7	14	0.04
25. CLARKIA SP.	-	-	7	-	-	-	-	-	-	-	--	-	7	0.02
26. CORIANDRUM SATIVUM	21	35	35	28	7	14	7	7	-	-	-	14	168	0.52
27. CORONOPUS DIDYNAMUS	-	-	7	-	-	-	-	-	-	-	-	-	7	0.02
28. CYPERACEAE	92	35	-	-	-	43	14	85	35	7	-	21	332	1.03
29. DELONIX REGIA	-	-	-	7	14	-	-	-	-	-	-	-	21	0.07
30. DIANTHUS SP.	7	-	-	-	-	-	-	-	-	-	-	-	7	0.02
31. DRYPETES ROXBURGHII	-	43	71	7	7	14	7	-	-	-	-	-	149	0.47
32. EMBLICA OFFICINALIS	-	-	21	7	-	-	14	-	-	-	-	-	42	0.13
33. EPHEDRA FOLIATA	21	14	7	7	-	-	-	7	-	-	-	-	56	0.18
34. EUCALYPTUS SP.	35	57	71	7	-	-	-	-	-	-	-	-	170	0.66
35. FERONIA LIMONIA	-	7	35	7	-	-	-	-	-	-	-	-	49	0.15
36. GNAPHALIUM SP	-	21	7	-	-	-	-	-	-	-	-	-	28	0.09

PLANT NAME	JAN	FEB	MAR	APR	MAY*	JUN	JUL	AUG	SEP	OCT	NOV*	DEC	TOTAL	PERCEN-TAGE
37. HOLOPTELEA INTERGRIFOLIA	163	1582	950	142	71	21	21	-	-	-	-	-	2950	9 20
38 IBERIS AMARA	7	43	35	-	-	-	-	-	-	-	-	-	85	0.26
39. IMPATIENS BALSAMINA	7	-	-	-	-	-	-	-	-	-	-	-	7	0.02
40. LATHYRUS ODORATUS	7	7	-	-	-	-	-	-	-	-	-		14	0.04
41. MADHUCA LONGIFOLIA	-	14	14	64	43	14	-	-	-	-	-	-	149	0.45
42. OTHER MALVACEAE	135	-	7	28	-	-	-	-	-	-	-	-	170	0.54
43. OTHER MONOCOTYLEDONS	135	305	199	43	447	78	170	106	35	128	71	92	1809	5.64
44. MORUS ALBA	-	28	21	28	7	28	7	7	7	-	-	-	133	0.41
45 OCIMUM SANCTUM	-	7	-	-	-	-	-	-	-	-	-	-	7	0.02
46. PARTHENIUM HYSTEROPHORUS	-	14	21	50	21	128	35	35	21	43	-	7	375	1.17
47. PHLOX DRUMMONDII	-	-	-	7	-	-	-	-	-	-	-	-	7	0 02
48. PHOENIX SYLVESTRIS	-	-	14	28	-	-	-	-	-	--	-	-	42	0.13
49. PINUS ROXBURGHII	14	362	113	78	14	-	14	-	-	14	-	-	609	1.90
50. PITHECELLOBIUM DULCE	-	-	7	-	-	-	-	-	-	-	-	-	7	0.02
51. POACEAE	1057	1333	872	915	277	302	511	1220	1922	2291	99	411	11270	35 2
52. POLYALTHIA LONGIFOLIA	-	-	14	43	35	-	-	-	-	-	-	-	92	0.28
53 POLYGONUM PLEBEIUM	-	21	-	14	7	14	7	-	-	-	-	-	63	0 22
54. PONGAMIA PINNATA	-	-	14	50	14	-	50	-	-	-	-	-	128	0.39
55. PROSOPIS JULIFLORA	21	-	-	64	-	-	-	-	-	-	-	-	85	0.26
56. PSIDIUM GUAJAVA	-	-	347	7	7	-	-	-	-	14	-	-	375	1.17
57. PTEROSPERMUM ACERIFOLIUM	21	-	-	7	-	-	-	-	-	-	-	-	28	0.09
58. RICINUS COMMUNIS	99	241	128	71	35	-	7	14	7	21	28	113	764	2.38
59. RORIPPA DUBIA	50	14	7	-	-	-	-	-	-	-	-	-	71	0.22
60. ROYSTONEA REGIA	-	-	35	28	-	-	-	-	-	-	-	-	63	0.19
61 RUMEX DENTATUS	14	14	-	-	-	-	-	-	-	-	-	-	28	0 09
62. SOLANACEAE	-	14	21	7	-	-	-	-	-	-	-	7	49	0 15
63 SPATHODEA SP.	-	7	-	-	-	-	-	-	-	-	-	-	7	0.02
64. STRYCHNOS NUX VOMICA	-	14	7	-	-	-	-	-	-	-	-	-	21	0.07
65. SYZYGIUM CUMINI	-	-	7	21	35	7	-	-	-	-	-	-	70	0.22
66. TERMINALIA ARJUNA	7	-	7	-	-	-	-	-	-	-	-	-	14	0.04
67. THESPESIA SP.	-	-	-	-	14	-	-	-	-	-	-	-	14	0 04
68. THUJA/CUPRESSUS	28	14	21	78	-	7	-	-	-	-	7	-	155	0.49
69 TINOSPORA CORDIFOLIA	-	14	28	14	-	-	14	57	28	43	-	-	198	0.60
70. TOONA CILIATA	-	50	7	7	-	-	-	-	-	-	-	-	64	0.19
71. TYPHA AUSTRALIS	-	-	106	1567	121	702	355	64	-	-	-	-	2915	9.11
72. URTICACEAE/MORACEAE	-	-	7	-	-	7	-	-	7	7	7	28	63	0.19
73. XANTHIUM STRUMERIUM	-	-	-	14	-	-	7	28	-	7	-	-	56	0.17
UNIDENTIFIED	184	440	851	709	128	142	128	149	170	177	50	198	3326	10.40
TOTAL	2785	5309	4936	4970	1431	1919	1601	2084	2607	3000	304	1102	32048	100

* Trap malfunction for major part of these months.

LECYTHIDACEAE

Barringtonia acutangula (L.) Gaertn. (Pl.6, Fig.58) Grains prolate spheroidal, size medium (30 X 28 μm), amb circular, 3-zonicolporoidate, angulaperturate, exine tegillate.

1990 - 91 Survey :	Total number of pollen grains :34
Site A	Period of occurrence : Mar - Aug
	Maximum occurrence : May (17)
	Minimum occurrence : Jun, Aug (2)
	Percentage contribution : 0.08

1991 - 92 Survey :	Total number of pollen grains :8
Site A	Period of occurrence : Jun, Aug
	Maximum occurrence : Aug (7)
	Minimum occurrence : Jun (1)
	Percentage contribution : 0.09

1991 - 92 Survey :	Total number of pollen grains :1
Site B	Period of occurrence : May
	Maximum occurrence : May (1)
	Minimum occurrence : May (1)
	Percentage contribution : 0.012

1991 Survey : Total number of pollen grains :127 m^{-3}

Site A Period of occurrence : Mar, Apr, Jul-Sep.

Maximum occurrence : Apr (92 m^{-3})

Minimum occurrence : Mar, Jul, Sep. (7m^{-3})

Percentage contribution : 0.039

LOGANIACEAE

Strychnos nux vomica L. (Pl.6, Fig.59) Grains prolate, size small (18 x 13 μm), amb triangular with convex sides, 3-zonicolporate, angulaperturate colpi alternating with 3 pseudocolpi, exine reticulate.

1991 Survey : Total number of pollen grains :21 m^{-3}

Site A Period of occurrence : Feb, Mar

Maximum occurrence : Feb (14 m^{-3})

Minimum occurrence : Mar (7 m^{-3})

Percentage contribution : 0.07

MALVACEAE

Abutilon indicum (L) Sweet. (Pl.7, Fig.60, 61) Grains spheroidal, size large (77 μm), amb circular, 3-zonicolpoidorate, circulaperturate, exine spinose.

1991 - 92 Survey : Total number of pollen grains :1

Site B Period of occurrence : Dec

Maximum occurrence : Dec (1)

Minimum occurrence : Dec (1)

Percentage contribution : 0.012

1991 Survey : Total number of pollen grains :7 m^{-3}

Site A Period of occurrence : Dec

Maximum occurrence : Dec (7 m^{-3})

Minimum occurrence : Dec (7 m^{-3})

Percentage contribution : 0.02

***Thespesia* sp.** Sol. ex. Correa. (Pl.7, Fig.62) Grains spheroidal, size large (95 µm), panporate, exine spinose, spines with broad base.

1991 Survey : Total number of pollen grains :14 m^{-3}

Site A Period of occurrence : May

Maximum occurrence : May (14 m^{-3})

Minimum occurrence : May (14 m^{-3})

Percentage contribution : 0.04

MELIACEAE

Azadirachta indica Juss. (Pl.7, Fig.65) Grains prolate spheroidal, size large (42 X 39 µm), amb circular, 4-5 zonicolporate, circulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :868

Site A Period of occurrence : Mar - Jun

Maximum occurrence : Apr (750)

Minimum occurrence : Jun (2)

Percentage contribution : 2.12

1991 - 92 Survey : Total number of pollen grains :55

Site A Period of occurrence : Apr - Jul

Maximum occurrence : Apr (43)

Minimum occurrence : Jul (1)

Percentage contribution : 0.65

1991 - 92 Survey : Total number of pollen grains :46

Site B Period of occurrence : Mar - May

Maximum occurrence : Apr (24)

Minimum occurrence : Mar (1)

Percentage contribution : 0.58

1991 Survey : Total number of pollen grains :269 m^{-3}

Site A Period of occurrence : Feb, Apr - Jun

Maximum occurrence : Apr (199 m^{-3})

Minimum occurrence : Feb (7 m^{-3})

Percentage contribution : 0.84

Toona ciliata Roemer. (Pl.7, Fig.66, 67) Grains oblate spheroidal, size small (16 X 17 µm), amb circular, 4-5 zonicolporate, circulaperturate, exine reticulate.

1990 - 91 Survey :	Total number of pollen grains :174
Site A	Period of occurrence : Feb, Mar
	Maximum occurrence : Feb (166)
	Minimum occurrence : Mar (8)
	Percentage contribution : 0.43

1991 - 92 Survey :	Total number of pollen grains :5
Site A	Period of occurrence : Mar - Apr
	Maximum occurrence : Mar (4)
	Minimum occurrence : Apr (1)
	Percentage contribution : 0.06

1991 - 92 Survey :	Total number of pollen grains :1
Site B	Period of occurrence : Feb - Apr
	Maximum occurrence : Mar (3)
	Minimum occurrence : Feb, Apr (2)
	Percentage contribution : 0.09

1991 Survey : Total number of pollen grains :64 m^{-3}

Site A Period of occurrence : Feb - Apr

Maximum occurrence : Feb (50 m^{-3})

Minimum occurrence : Mar, Apr. (7m^{-3})

Percentage contribution : 0.19 .

MENISPERMACEAE

Tinospora cordifolia - (Willd.) Hook f. & Thoms. (Pl.7, Fig.68) Gains subprolate, size small (16 X 14 µm), amb triangular with rounded angles, 3-zonicolporoidate, planaperturate, syncolpate, colpi operculate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :63

Site A Period of occurrence : Feb - Oct.

Maximum occurrence : Aug (26)

Minimum occurrence : May, Jun, Oct (1)

Percentage contribution : 0.15

1991 - 92 Survey : Total number of pollen grains :17

Site A Period of occurrence : Jul - Oct

Maximum occurrence : Aug (11)

Minimum occurrence : Oct (1)

Percentage contribution : 0.20

1991 Survey : Total number of pollen grains :198 m^{-3}

Site A Period of occurrence : Feb-Apr, Jul-Oct.

Maximum occurrence : Aug (57 m^{-3})

Minimum occurrence : Feb, Apr, Jul (14m^{-3})

Percentage contribution : 0.60

MORACEAE

Morus alba L. (Pl.7, Fig.69) Grains bilateral, size small (10 X 14 μm), 2 - zoniporate, circulaperturate, exine psilate.

1990 - 91 Survey : Total number of pollen grains :229

Site A Period of occurrence : Jan - Jul, Sept, Oct.

Maximum occurrence : Feb (129)

Minimum occurrence : Sept (1)

Percentage contribution : 0.56

1991 - 92 Survey : Total number of pollen grains :20

Site A Period of occurrence : Jan, Feb, Apr-Jul

Maximum occurrence : May (8)

Minimum occurrence : Feb, Jul (1)

Percentage contribution : 0.24

1991 - 92 Survey : Total number of pollen grains :6

Site B Period of occurrence : Mar-May, Jul.

Maximum occurrence : Mar (3)

Minimum occurrence : Apr, May, Jul (1)

Percentage contribution : 0.08

1991 Survey : Total number of pollen grains :133 m^{-3}

Site A Period of occurrence : Feb - Sep

Maximum occurrence : Feb, Apr, Jun (28 m^{-3})

Minimum occurrence : May, Jul, Aug, Sep(7m^{-3})

Percentage contribution : 0.41

MYRTACEAE

Callistemon citrinus (Cutis) skeels, (Pl.8, Fig.71) Grains oblate, size small (16 X 22 μm), amb triangular, 3-zonicolporate, angulaperturate, parasyncolpate, exine psilate.

1990 - 91 Survey : Total number of pollen grains :384

Site A Period of occurrence : Throughout the year.

Maximum occurrence : Dec (159)

Minimum occurrence : Jul, Aug (1)

Percentage contribution : 0.94

1991 - 92 Survey : Total number of pollen grains :77

Site A

Period of occurrence : Nov-May, Jul, Sep.

Maximum occurrence : Nov (15)

Minimum occurrence : Jul (2)

Percentage contribution : 0.90

1991 - 92 Survey : Total number of pollen grains :21

Site B

Period of occurrence : Mar-May, Sep-Dec.

Maximum occurrence : Mar (5)

Minimum occurrence : Sep (1)

Percentage contribution : 0.26

1991 Survey : Total number of pollen grains :431 m^{-3}

Site A

Period of occurrence : Sep - Jun

Maximum occurrence : Jan (113 m^{-3})

Minimum occurrence : Oct (7m^{-3})

Percentage contribution : 1.34

***Eucalyptus* sp.** L'Herit. (Pl.8, Fig.72) Grains oblate, size small (17 X 24 μm), amb triangular, 3-zonicolporate, angulaperturate, exine granular.

1990 - 91 Survey : Total number of pollen grains :130

Site A

Period of occurrence : Oct - Apr

	Maximum occurrence : Feb (89)
	Minimum occurrence : Nov (2)
	Percentage contribution : 0.32
1991 - 92 Survey :	Total number of pollen grains :30
Site A	Period of occurrence : No - Apr
	Maximum occurrence : Dec (10)
	Minimum occurrence : Apr (1)
	Percentage contribution : 0.35
1991 - 92 Survey :	Total number of pollen grains : 45
Site B	Period of occurrence : Nov-Jan, Mar
	Maximum occurrence : Dec (26)
	Minimum occurrence : Mar (1)
	Percentage contribution : 0.56
1991 Survey :	Total number of pollen grains :170 m^{-3}
Site A	Period of occurrence : Jan - Apr
	Maximum occurrence : Mar (71 m^{-3})
	Minimum occurrence : Apr (7m^{-3})
	Percentage contribution : 0.66

Psidium guajava L. (Pl.8, Fig.74) Grains oblate, size small (14 X 19 μm), amb triangular to quadrangular, 3-4 zonicolporate, angulaperturate, exine granulate.

1991 - 92 Survey : Total number of pollen grains :15

Site A
Period of occurrence : Jul-Aug, Oct-Dec

Maximum occurrence : Aug (5)

Minimum occurrence : Jul, Dec (1)

Percentage contribution : 0.18

1991 - 92 Survey : Total number of pollen grains :18

Site B
Period of occurrence : Jul-Sept, Nov.

Maximum occurrence : Jul (9)

Minimum occurrence : Sept, Nov (2)

Percentage contribution : 0.23

1991 Survey : Total number of pollen grains :375 m^{-3}

Site A
Period of occurrence : Mar - May, Oct.

Maximum occurrence : Mar (347 m^{-3})

Minimum occurrence : Apr, Mar (7m^{-3})

Percentage contribution : 1.14

Syzygium cumini (L) Skeels. (Pl.8, Fig.73) Grains oblate, size small (12 X 22 μm) amb triangular, 3-zonicolporate, angulaperturate, exine psilate.

1990 - 91 Survey :	Total number of pollen grains :96
Site A	Period of occurrence : Apr, May.
	Maximum occurrence : May (95)
	Minimum occurrence : Apr (1)
	Percentage contribution : 0.23

1991 - 92 Survey :	Total number of pollen grains :37
Site A	Period of occurrence : Mar-Aug
	Maximum occurrence : May (28)
	Minimum occurrence : Jun, Aug (1)
	Percentage contribution : 0.44

1991 - 92 Survey :	Total number of pollen grains :2
Site B	Period of occurrence : May, Jun
	Maximum occurrence : May, Jun (1)
	Minimum occurrence : May, Jun (1)
	Percentage contribution : 0.03

1991 Survey :	Total number of pollen grains :70 m^{-3}
Site A	Period of occurrence : Mar - Jun
	Maximum occurrence : Apr (21 m^{-3})
	Minimum occurrence : Mar, Jun (7m^{-3})

Percentage contribution : 0.22

NYCTAGINACEAE

***Bougainvillea* sp.** Comm. ex, Juss. mut. Choisy (Pl.8, Fig.75) Grians oblate, (25 X 31 μm) size rather small amb circular, 3-zonicolpate, circulaperturate, exine retipilate, free collumellae in lumina.

1990 - 91 Survey : Total number of pollen grains :2

Site A Period of occurrence : Dec

Maximum occurrence : Dec (2)

Minimum occurrence : Dec (2)

Percentage contribution : 0.005

Mirabilis jalapa L. (Pl.8, Fig.77) Grains spheroidal, size very large (102 μm), amb circular, panporate, exine spinulose, punctate.

1990 - 91 Survey : Total number of pollen grains :1

Site A Period of occurrence : Mar

Maximum occurrence : Mar (1)

Minimum occurrence : Mar (1)

Percentage contribution : 0.002

ONAGRACEAE

Clarkia sp. Pursh. (Pl.8, Fig.78) Grains peroblate, very large (110 μm), amb triangular with slightly concave sides, 3-zoniporate, angulaperturate, exine protruding at pores, prilate , intine forming prominent buldges at pores.

1991 Survey : Total number of pollen grains :7 m^{-3}

Site A Period of occurrence : Mar

Maximum occurrence : Mar (7 m^{-3})

Minimum occurrence : Mar (7m^{-3})

Percentage contribution : 0.02

PAPAVERACEAE

Argemone mexicana L. (Pl.8, Fig.79) Grains oblate spheroidal, size medium (35 x 38 μm), 3-zonicolpate, Occasionally 4-zonicolpate, angulaperturate, exine finely reticulate.

1990 - 91 Survey : Total number of pollen grains :8

Site A Period of occurrence : Mar, Apr.

Maximum occurrence : Mar, Apr (4)

Minimum occurrence : Mar, Apr (4)

Percentage contribution : 0.02

1991 - 92 Survey : Total number of pollen grains :1

Site B Period of occurrence : Apr

Maximum occurrence : Apr (1)

Minimum occurrence : Apr (1)

Percentage contribution : 0.012

PLANTAGINACEAE

Plantago **sp.**, L. (Pl.8, Fig.76) Grains spheroidal , size small (22 μm), panporate, pores 7-10, operculate, exine reticulate.

1991 - 92 Survey : Total number of pollen grains :16

Site A Period of occurrence : Dec-Jan

Maximum occurrence : Dec (11)

Minimum occurrence : Jan (5)

Percentage contribution : 0.19

POLEMONIACEAE

Phlox drummondii Hooker (Pl.8, Figs.80, 81) Grains spheroidal, size small (30 μm) , amb circular, panporate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :5

Site A Period of occurrence : Mar

Maximum occurrence : Mar (5)

Minimum occurrence : Mar (5)

Percentage contribution : 0.012

1991 - 92 Survey : Total number of pollen grains :2

Site A Period of occurrence : Feb, Apr

Maximum occurrence : Feb, Apr (1)

Minimum occurrence : Feb, Apr (1)

Percentage contribution : 0.02

1991 Survey : Total number of pollen grains :7 m^{-3}

Site A Period of occurrence : Apr

Maximum occurrence : Apr (7 m^{-3})

Minimum occurrence : Apr (7m^{-3})

Percentage contribution : 0.02

POLYGONACEAE

Polygonum plebeium R. Br. (Pl.8, Fig.82) Gains subprolate, size small (15 X 12 μm), amb circular, 3 zonicolporate, circulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :54

Site A Period of occurrence : Feb - May

Maximum occurrence : May (95)

Minimum occurrence : Feb, Mar (1)

Percentage contribution : 0.13

1991 - 92 Survey : Total number of pollen grains :16

Site A Period of occurrence : May, Jun

Maximum occurrence : May (15)

Minimum occurrence : Jun (1)

Percentage contribution : 0.19

1991 - 92 Survey : Total number of pollen grains :8

Site B Period of occurrence : Mar - May, Dec, Jan

Maximum occurrence : May (3)

Minimum occurrence : Mar, Dec, Jan (1)

Percentage contribution : 0.10

1991 Survey : Total number of pollen grains :63 m^{-3}

Site A Period of occurrence : Feb, Apr - Jul

Maximum occurrence : Feb (21 m^{-3})

Minimum occurrence : May, Jul (7m^{-3})

Percentage contribution : 0.22

Rumex dentatus L. (Pl. 9 Fig.84) Grains oblate spheroidal, size small (26 X 28 μm), amb circular, 3-zonicolporate, circulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :34

Site A Period of occurrence : Dec - May

Maximum occurrence : Feb (16)

Minimum occurrence : Jan, Apr (1)

Percentage contribution : 0.08

1991 - 92 Survey : Total number of pollen grains :14

Site A Period of occurrence : Feb, Mar

Maximum occurrence : Mar (8)

Minimum occurrence : Feb (6)

Percentage contribution : 0.17

1991 - 92 Survey : Total number of pollen grains :3

Site B Period of occurrence : Mar, May, Dec

Maximum occurrence : Mar, May, Dec (1)

Minimum occurrence : Mar, May, Dec (1)

Percentage contribution : 0.04

1991 Survey : Total number of pollen grains :28 m^{-3}

Site A Period of occurrence : Jan, Feb

Maximum occurrence : Jan, Feb (14 m^{-3})

Minimum occurrence : Jan, Feb (14 m^{-3})

Percentage contribution : 0.09

PORTULACACEAE

Portulaca sp. L. (Pl.9, Fig.85) Grains spheroical, size large (70 μm), polyrugate, exine retipilate.

1990 - 91 Survey : Total number of pollen grains :2

Site A Period of occurrence : Apr

Maximum occurrence : Apr (2)

Minimum occurrence : Apr (2)

Percentage contribution : 0.005

RUTACEAE

Aegle marmelos L. Correa (Pl.9, Fig.87) Grains oblate spheroidal, size small (24 X 25 μm), amb circular, 4 - zonicolporate, circulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :94

Site A Period of occurrence : May - Jul

Maximum occurrence : May (65)

Minimum occurrence : Jul (1)

Percentage contribution : 0.23

1991 - 92 Survey : Total number of pollen grains :12

Site A Period of occurrence : Apr, May

Maximum occurrence : May (7)

Minimum occurrence : Apr (5)

Percentage contribution : 0.14

1991 - 92 Survey : Total number of pollen grains :10

Site B Period of occurrence : May, Oct.

Maximum occurrence : May (8)

Minimum occurrence : Oct (2)

Percentage contribution : 0.13

1991 Survey : Total number of pollen grains :77 m^{-3}

Site A Period of occurrence : Mar - Jul, Sep.

Maximum occurrence : Jun (35 m^{-3})

Minimum occurrence : Mar, May, Jul, Sep(7m^{-3})

Percentage contribution : 0.24

Feronia limonia (L.) Swingle (Pl.9, Fig.88) Grains prolate spheroidal, size small (25 X 23 μm), amb more or less quadrangular, 4 - zonicolporate, angularperturate, exine finely reticulate.

1990 - 91 Survey : Total number of pollen grains :8

Site A Period of occurrence : Apr

Maximum occurrence : Apr (8)

Minimum occurrence : Apr (8)

Percentage contribution : 0.02

1991 - 92 Survey : Total number of pollen grains :5

Site A Period of occurrence : Mar, Jun

Maximum occurrence : Mar (3)

Minimum occurrence : Jun (2)

Percentage contribution : 0.06

1991 - 92 Survey : Total number of pollen grains :3

Site B Period of occurrence : Apr

Maximum occurrence : Apr (3)

Minimum occurrence : Apr (3)

Percentage contribution : 0.04

1991 Survey : Total number of pollen grains :49 m^{-3}

Site A Period of occurrence : Feb - Apr

Maximum occurrence : Mar (35 m^{-3})

Minimum occurrence : Mar, Apr (7m^{-3})

Percentage contribution : 0.15

Murraya koenigii (L.) Spreng. (Pl.9, Fig.86) Grains spheroidal, size medium (35 µm), amb circular, 3-zonicolporate, circulaperturate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :31

Site A

Period of occurrence : Mar - May

Maximum occurrence : Apr (23)

Minimum occurrence : May (3)

Percentage contribution : 0.08

SANTALACEAE

Santalum album L. (Pl.9, Fig.83) Grains subprolate, size small (23 X 19 µm), amb triangular with convex sides, 3 zoniporate, angulaperturate, exine faintly reticulate, incrassate at the margin of the pore.

1990 - 91 Survey : Total number of pollen grains :5

Site A

Period of occurrence : Oct

Maximum occurrence : Oct (5)

Minimum occurrence : Oct (5)

Percentage contribution : 0.01

SAPOTACEAE

Madhuca longifolia (Koenig) Macbridge (Pl.9, Fig.94, 95) Grains prolate spheroidals size rather large (43 X 38 μm), amb circular, 4-5 zonicolporate, circulaperturate, exine psilate.

1990 - 91 Survey :	Total number of pollen grains :1689
Site A	Period of occurrence : Mar - May
	Maximum occurrence : Apr (1451)
	Minimum occurrence : May (85)
	Percentage contribution : 4.13

1991 - 92 Survey :	Total number of pollen grains :302
Site A	Period of occurrence : Mar - Jul
	Maximum occurrence : Apr (250)
	Minimum occurrence : Jul (1)
	Percentage contribution : 3.57

1991 - 92 Survey :	Total number of pollen grains :84
Site B	Period of occurrence : Mar - Jul
	Maximum occurrence : Apr (55)
	Minimum occurrence : Jun, Jul (1)
	Percentage contribution : 1.05

1991 Survey : Total number of pollen grains :149 m^{-3}

Site A Period of occurranec : Feb - Jun

Maximum occurrence : Apr (64 m^{-3})

Minimum occurrence : Feb, Mar, Jun (14m^{-3})

Percentage contribution : 0.45

SIMAROUBIACEAE

Ailanthus excelsa L. (Pl.9, Fig.89) Grains oblate spheroidal, size rather small (25 X 29 μm), amb subtriangular, 3 - zonicolporate, angulaperturate, exine finely reticulate.

1990 - 91 Survey : Total number of pollen grains :400

Site A Period of occurrence : Jan - Jun

Maximum occurrence : Feb (373)

Minimum occurrence : Jan, Apr, Jun (1)

Percentage contribution : 0.98

1991 - 92 Survey : Total number of pollen grains :45

Site A Period of occurrence : Feb - May

Maximum occurrence : Feb (29)

Minimum occurrence : May (1)

Percentage contribution : 0.53

1991 - 92 Survey : Total number of pollen grains :44

Site B

Period of occurrence : Feb - June

Maximum occurrence : Feb (26)

Minimum occurrence : Apr, May (1)

Percentage contribution : 0.55

1991 Survey : Total number of pollen grains :185 m^{-3}

Site A

Period of occurrence : Jan - Apr, Jun, Jul

Maximum occurrence : May (64 m^{-3})

Minimum occurrence : Jun, Jul (7m^{-3})

Percentage contribution : 0.56

STERCULIACEAE

Pterospermum acerifolium (L.) willd. (Pl.9, Fig.92) Grains oblate spheroidal, size large (53 X 58 μm), amb circular, 3 - zonicolporate, cirulaperturate, exine spinose.

1990 - 91 Survey : Total number of pollen grains :23

Site A

Period of occurrence : Mar, Apr

Maximum occurrence : Mar (21)

Minimum occurrence : Apr (2)

Percentage contribution : 0.06

1991 - 92 Survey : Total number of pollen grains :9

Site A Period of occurrence : Jan, Mar

Maximum occurrence : Jan (8)

Minimum occurrence : Mar (1)

Percentage contribution : 0.11

1991 Survey : Total number of pollen grains :28 m^{-3}

Site A Period of occurrence : Jan, Apr

Maximum occurrence : Jan (21 m^{-3})

Minimum occurrence : Apr (7m^{-3})

Percentage contribution : 0.09

ULMACEAE

Holoptelea integrifolia (Roxb.) Planch. (Pl.9, Fig.90) Grains suboblate, size small (21 X 25 μm), amb circular, 4-5 zonicolporate, cirulaperturate, exine coarsely granular.

1990 - 91 Survey : Total number of pollen grains :8933

Site A Period of occurrence : Jan - May

Maximum occurrence : Feb (7994)

Minimum occurrence : Jan (3)

Percentage contribution : 21.9

1991 - 92 Survey : Total number of pollen grains :1245

Site A Period of occurrence : Jan - Jul

Maximum occurrence : Feb (942)

Minimum occurrence : Jan, Jun (2)

Percentage contribution : 14.7

1991 - 92 Survey : Total number of pollen grains :862

Site B Period of occurrence : Jan - Jul

Maximum occurrence : Feb (674)

Minimum occurrence : Jun, Jul (2)

Percentage contribution : 10.80

1991 Survey : Total number of pollen grains :2950 m^{-3}

Site A Period of occurrence : Jan - Jul

Maximum occurrence : Feb (1582 m^{-3})

Minimum occurrence : Jun, Jul (21 m^{-3})

Percentage contribution : 9.20

MONOCOTYLEDONS

ARECACEAE

Borassus flabellifer L. (Pl.10, Fig.97) Grains ellipsoidal, size large (42 X 55 µm), 1-anacolpate, exine verrucate.

1990 - 91 Survey : Total number of pollen grains :4

Site A Period of occurrence : Jul

Maximum occurrence : Jul (4)

Minimum occurrence : Jul (4)

Percentage contribution : 0.01

1991 Survey : Total number of pollen grains :14 m^{-3}

Site A Period of occurrence : Apr, Jul

Maximum occurrence : Apr, Jul (7 m^{-3})

Minimum occurrence : Apr, Jul (7m^{-3})

Percentage contribution : 0.04

Caryota urens L. (Pl.10, Fig.98) Grains elliptical, size small (16 X 22 µm), amb cirular, 1 - anacolpate, exine psilate.

1990 - 91 Survey : Total number of pollen grains :1002

Site A Period of occurrence : Jan - Apr, Jun

Maximum occurrence : Feb (1)

Minimum occurrence : Mar (1)

Percentage contribution : 2.45

1991 - 92 Survey : Total number of pollen grains :75

Site A Period of occurrence : May - Aug, Jan, Feb

Maximum occurrence : Jul (26)

Minimum occurrence : May (1)

Percentage contribution : 0.89

1991 - 92 Survey : Total number of pollen grains :14

Site B Period of occurrence : Feb, Mar.

Maximum occurrence : Mar (10)

Minimum occurrence : Feb (4)

Percentage contribution : 0.18

1991 Survey : Total number of pollen grains :226 m^{-3}

Site A Period of occurrence : Jan - Apr, Jun.

Maximum occurrence : Feb (85 m^{-3})

Minimum occurrence : Apr (7m^{-3})

Percentage contribution : 0.73

Phoenix sylvestris L. (Roxb.) (Pl.10, Fig.100) Grains ellipsoidal, size small (12 X 22 μm), amb circular, 1-anacolpate, exine psilate.

1990 - 91 Survey : Total number of pollen grains :195

Site A Period of occurrence : Feb - May

Maximum occurrence : Mar (92)

Minimum occurrence : May (4)

Percentage contribution : 0.48

1991 - 92 Survey : Total number of pollen grains :86

Site A Period of occurrence : Jan - May

Maximum occurrence : Feb (36)

Minimum occurrence : Apr (2)

Percentage contribution : 1.02

1991 Survey : Total number of pollen grains :42 m^{-3}

Site A Period of occurrence : Mar, Apr

Maximum occurrence : Apr (28 m^{-3})

Minimum occurrence : Mar (14 m^{-3})

Percentage contribution : 0.13

Roystonea regia (H. B. K.) O. F. Cook. (Pl.10, Fig.99) Grains oblate spheroidal, size medium (31 X 35 µm), amb spheroidal, 1-anacolpate, exine psilate.

1990 - 91 Survey : Total number of pollen grains :255

Site A Period of occurrence : Dec - Jan

Maximum occurrence : Jan (220)

Minimum occurrence : Dec (4)

Percentage contribution :

1991 - 92 Survey : Total number of pollen grains :11

Site A Period of occurrence : Dec - Jan, Apr

Maximum occurrence : Jan (5)

Minimum occurrence : Apr (2)

Percentage contribution : 0.13

1991 Survey : Total number of pollen grains :63 m^{-3}

Site A Period of occurrence : Mar, Apr

Maximum occurrence : Mar (35 m^{-3})

Minimum occurrence : Apr (28 m^{-3})

Percentage contribution : 0.19

CYPERACEAE

Cyperaceae Juss. (Pl.10, Figs.102, 103) Grain pear sphaped, size medium to rather large, (31 - 51 X 21 - 31 µm), 1 - anaporate, pore on broader side, exine psilate.

1990 - 91 Survey : Total number of pollen grains :145

Site A Period of occurrence : May - Dec, Feb, Mar

Maximum occurrence : Aug (59)

Minimum occurrence : Nov (1)

Percentage contribution : 0.35

1991 - 92 Survey : Total number of pollen grains :124

Site A Period of occurrence : Throughout the year.

Maximum occurrence : Aug (40)

Minimum occurrence : Nov, Dec, Mar (1)

Percentage contribution : 1.46

1991 - 92 Survey : Total number of pollen grains :94

Site B Period of occurrence : Feb - Dec

Maximum occurrence : Aug (32)

Minimum occurrence : Apr, Dec (1)

Percentage contribution : 1.18

1991 Survey : Total number of pollen grains :332 m^{-3}

Site A Period of occurrence : Dec - Feb, Jun - Oct

Maximum occurrence : Jan (92 m^{-3})

Minimum occurrence : Oct (7m^{-3})

Percentage contribution : 1.03

POACEAE

Poaceae Barnhart (Pl.10, Figs.104, 106) Grains spheroidal , size small to large (20 - 56 µm), 1-anaporate, operculate, exine psilate.

1990 - 91 Survey : Total number of pollen grains :10356

Site A Period of occurrence : Throughout the year.

Maximum occurrence : Oct (5161)

Minimum occurrence : Jan (95)

Percentage contribution : 25.34

1991 - 92 Survey : Total number of pollen grains :2748

Site A Period of occurrence : Throughout the year

Maximum occurrence : Oct (794)

Minimum occurrence : Jun (56)

Percentage contribution : 32.44

1991 - 92 Survey : Total number of pollen grains :3290

Site B Period of occurrence : Throughout the year

Maximum occurrence : Oct (1190)

Minimum occurrence : Jan (53)

Percentage contribution : 41.21

1991 Survey : Total number of pollen grains :11270 m^{-3}

Site A Period of occurrence : Throughout the year

Maximum occurrence : Oct (2291 m^{-3})

Minimum occurrence : Jun (277m^{-3})

Percentage contribution : 35.2

TYPHACEAE

TABLE : 5 MONTHLY TOTALS OF AIRBORNE POLLEN GRAINS AT TWO SITES (A& B) DURING 1991-1992

PLANT NAME	SITE	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	TOTAL	PERCEN-TAGE
1 ABUTILON SP.	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-	-	1	-	1	0.01
2 ACACIA NILOTICA	A	-	-	-	-	-	1	4	5	2	-	-	-	12	0.14
	B	-	-	-	-	-	2	3	3	3	2	1	-	14	0 18
3. OTHER ACANTHACEAE	A	-	-	2	-	-	-	-	-	-	-	1	-	3	0 04
	B	-	1	-	-	-	1	-	-	-	2	1	-	5	0 63
4. AEGLE MARMELOS	A	-	-	5	7	-	-	-	-	-	-	-	-	12	0.14
	B	-	-	-	8	-	-	-	-	2	-	-	-	10	0.13
5. AI LANTHUS EXCELA	A	29	12	3	1	-	-	-	-	-	-	-	-	45	0.53
	B	26	14	1	1	2	-	-	-	-	-	-	-	44	0.55
6. ALNUS SP.	A	10	-	-	2	-	-	-	-	6	13	1	1	33	0.39
	B	7	16	-	-	-	-	-	-	14	5	2	1	45	0.56
7 ALTERNANTHERA	A	-	-	-	-	-	-	-	1	-	-	1	-	2	0.02
SESSI LI S	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8 AMARNTHACEAE/	A	24	73	22	24	11	20	27	34	71	40	38	49	433	5.11
CHENOPODIACEAE	B	19	72	25	15	2	15	39	73	84	39	10	29	422	5.29
9. OTHER APIACEAE	A	2	-	-	1	-	-	-	-	-	-	-	-	3	0.04
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. ARGEMONE	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MEXICANA	B	-	-	1	-	-	-	-	-	-	-	-	-	1	0 01
11. ARTEMI SI A SP.	A	-	-	-	-	-	2	-	5	43	10	2	-	62	0.73
	B	-	-	-	2	1	-	-	21	39	9	-	-	72	0.90
12. OTHER ASTERACEAE	A	4	-	5	4	4	13	3	5	3	7	4	-	52	0.61
	B	5	1	7	5	-	2	3	4	7	1	17	48	100	1.25
13. AZADIRACHTA INDICA	A	-	-	43	6	5	1	-	-	-	-	-	-	55	0.65
	B	-	1	24	21	-	-	-	-	-	-	-	-	46	0.58
14 BARRINGTONIA	A	-	-	-	-	1	-	7	-	-	-	-	-	8	0 08
ACUTANGULA	B	-	-	-	1	-	-	-	-	-	-	-	-	1	0 01
15. BOMBAX CEIBA	A	4	-	-	-	-	-	-	-	-	-	-	-	4	0.05
	B	-	1	-	-	-	-	-	-	-	-	-	-	1	0 01
16. BRASSICA SP.	A	41	12	3	2	1	4	-	2	-	20	24	49	158	1.87
	B	49	14	5	-	-	-	-	-	-	9	50	87	214	2 68
17. CAJANAS CAJAN	A	-	2	-	-	-	-	-	-	-	-	-	-	2	0 02
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-

PLANT NAME	SITE	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	TOTAL	PERCENTAGE
18 CALLISTEMON	A	13	6	10	5	-	2	-	9	-	15	5	12	77	0.90
CITRINUS	B	-	5	4	3	-	-	-	1	2	3	3	-	21	0.26
19 CANNABIS SATIVA	A	-	9	3	9	2	-	2	1	2	-	-	-	28	0.33
	B	-	4	3	10	-	-	-	-	1	1	-	-	19	0.23
20. CARYOTA URENS	A	12	-	-	1	23	26	2	-	-	-	-	11	75	0.89
	B	4	10	-	-	-	-	-	-	-	-	-	-	14	0.18
21. CASSIA SPP.	A	1	-	5	2	-	-	2	-	5	20	6	-	41	0.48
	B	-	5	-	-	-	-	-	-	7	4	6	1	23	0.29
22. CASUARINA A	A	10	-	2	-	-	-	-	-	-	-	-	2	14	0.17
EQUISETIFOLIA	B	3	-	-	-	-	-	-	-	-	-	-	-	3	0.04
23. CELOSIA CRISTATA	A	-	2	-		-	-	-	-	-	-	-	-	2	0.02
	B	-	-	-	1	-	-	-	-	-	-	-	-	1	0.01
24. CORIANDRUM	A	3	10	1	1	-	-	-	-	-	-	-	41	56	0.66
SATIVUM	B	8	11	2	-	-	-	-	-	-	-	3	2	26	0.33
25 CORONOPUS	A	-	-	-	-	-	-	-	-	-		-	9	9	0.10
DIDYNAMUS	B	-	-	-	-	-	-	-	-	-	-	-	11	11	0.14
26. CROTON	A	-	-	-	-	-	-	1	1	-	-	-	-	2	0.02
BONPLANDIANUM	B	-	-	2	-	-	-	9	4	7			-	22	0.28
27. CYPERACEAE	A	3	1	2	2	7	3	40	39	18	1	1	7	124	1.46
	B	9	6	1	3	3	4	32	23	10	2	1	-	94	1.18
28. DELONIX REGIA.	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	17	42	6	-	-	-	-	-	-	-	65	0.81
29. DIANTHUS SP	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-	-	-	1	1	0.01
30. DRYPETES	A	11	31	32	1	6	-	-	-	-	-	-	1	82	0.97
ROXBURGHII	B	2	36	3	5	-	-	-	-	-	-	-	-	46	0.58
31 EMBLICA	A	-	5	9	-	1	2	-	-	-	-	-	-	17	0.20
OFFICINALIS	B	-	-	3	-	-	-	-	-	-	-	-	-	3	0.04
32 EPHEDRA	A	1	1	2	-	-	-	-	-	-	-	-	2	6	0.07
FOLIATA	B	-	-	-	-	-	-	-	-	-	--	-	-	-	-
33. EUCALYPTUS SP.	A	6	3	1	-	-	-	--	-	-	8	10	2	30	0.35
	B	-	1	-	-	-	-	-	-	-	4	26	14	45	0.56
34. FERONIA LIMONIA	A	-	3	-	-	2	-	-	-	-	--	-	-	5	0.06
	B	-	-	3	-	-	-	-	-	-	-	-	-	3	0.04
35. GNAPHALIUM SP.	A	-	1	-	-	-	-	-	-	-	-	-	-	1	0.01
	B	2	5	-	-	-	1	-	-	-	-	-	-	8	0.10
36 GOMPHRENA	A	-	-	-	-	-	1	-	-	-	-	-	-	1	0.01
GLOBOSA	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-

PLANT NAME	SITE	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	TOTAL	PERCEN-TAGE
37 HOLOPTELEA	A	942	252	31	2	3	-	-	-	-	-	-	2	1245	14 70
INTEGRIFOLIA	B	674	162	8	3	2	2	-	-	-	-	-	11	862	10.80
38. IBERIS AMARA	A	2	-	5	-	-	-	-	-	-	-	1	4	12	0 14
	B	-	-	-	-	-	-	-	-	-	-	-	7	7	0 09
39. MADHUCA	A	-	30	250	18	3	1	-	-	-	-	-	-	302	3 57
LONGIFOLIA	B	-	19	55	8	1	1	-	-	-	-	-	-	84	1 05
40 OTHER	A	-	-	2	-	7	-	-	1	-	-	-	1	11	0.13
MALVACEAE	B	1	-	-	1	-	-	-	-	1	-	-	-	3	0 04
41. MILLETIA	A	-	-	1	-	-	-	-	-	-	-	-	-	1	0 01
PEGUENSIS	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42. OTHER	A	35	30	11	56	21	69	31	9	35	56	6	25	484	5 71
MONOCOTYLEDONS	B	46	49	95	73	65	30	8	11	19	50	10	230	686	8.59
43. MORUS ALBA	A	1	-	3	8	3	1	-	-	-	-	-	4	20	0 24
	B	-	3	1	1	-	1	-	-	-	-	-	-	6	0 08
44. PARTHENIUM	A	-	10	90	26	12	31	13	26	12	18	10	2	250	2.95
HYSTEROPHORUS	B	15	16	43	31	37	74	38	12	50	43	34	22	415	5 20
45 PELTOPHORUM	A	-	-	1	-	-	4	-	3-	-	-	-	-	8	0 09
PTEROCARPUM	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46. PHOENIX	A	36	31	2	8	-	-	-	-	-	-	-	9	86	1.02
SYLVESTRI S	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
47. PHLOX	A	1	-	1	-	-	-	-	-	-	-	-	-	2	0.02
DRUMMONDII	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48. PINUS	A	90	23	10	1	5	-	-	2	1	-	1	-	133	1.57
ROXBURGHII	B	15	3	-	-	-	-	-	-	3	7	2	-	30	0.38
49. PLANTAGO SP.	A	-	-	-	-	-	-	-	-	-	-	11	5	16	0.19
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50. POACEAE	A	69	140	135	73	56	177	255	623	794	245	106	75	2748	32.44
	B	140	185	158	122	86	119	208	435	1190	392	202	53	3290	41 21
51. POLYALTHIA	A	-	-	36	5	-	-	-	-	-	-	-	-	41	0 48
LONGIFOLIA	B	-	-	2	-	1	-	-	-	-	-	-	-	3	0.04
52. POLYGONUM	A	-	-	-	15	1	-	-	-	-	-	-	-	16	0.19
PLEBEIUM	B	-	1	2	3	-	-	-	-	-	-	1	1	8	0 10
53. PONGAMIA	A	-	-	45	11	-	-	-	-	-	-	-	-	56	0.66
PINNATA	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
54. PROSOPIS	A	1	4	7	3	-	-	-	-	-	2	-	-	17	0.02
JULIFLORA	B	-	19	2	-	-	-	-	-	-	1	-	-	22	0.28
55 PSIDIUM	A	-	-	-	-	-	1	5	-	4	4	1	-	15	0.18
GUAJAVA	B	-	-	-	-	-	9	5	2	-	2	-	-	18	0 23

PLANT NAME	SITE	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	TOTAL	PERCEN-TAGE
56. PTEROSPERMUM	A	-	1	-	-	-	-	-	-	-	-	-	8	9	0.11
ACERIFOLIUM	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57. RICINUS COMMUNIS	A	156	62	8	-	-	-	-	1	16	31	56	75	405	4.78
	B	142	40	6	1	-	-	-	2	31	69	108	124	523	6.55
58 RORIPPA	A	-	-	-	-	-	-	-	-	-	-	2	1	3	0 04
DUBIA	B	1	1	-	-	-	-	-	-	-	-	6	1	9	0 11
59 ROYSTONEA REGIA	A	-	-	2	-	-	-	-	-	-	-	4	5	11	0.13
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60 RUMEX DENTATUS	A	6	8	-	-	-	-	-	-	-	-	-	-	14	0 17
	B	-	1	-	1	-	-	-	-	-	-	1	-	3	0 04
61. OTHER	A	-	2	1	-	-	-	-	-	-	-	-	-	3	0 04
SOLANACEAE	B	-	-	4	5	-	-	-	-	1	-	1	-	11	0.14
62. SAMANEA SAMAN	A	-	-	1	-	-	-	-	-	-	-	-	-	1	0.01
	B	-	-	-	-	-		-	-	-	-	-	-	-	-
63. SPATHODEA SP.	A	-	1	-	1	-	-	-	-	-	-	-	-	2	0 02
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64. SYZYGIUM CUMINI	A	2	3	28	1	2	1	-	-	-	-	-	-	37	0.44
	B	-	-	-	1	1	-	-	-	-	-	-	-	2	0.03
65 TAMARINDUS INDICA	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	1	-		-	-	-	-	-	1	0 01
66. TERMINALIA ARJUNA	A	2	-	-	-	-	-	-	-	-	-	-	-	2	0.02
	B	-	-	-	-	1	-	-	-	-	-	-	-	1	0 01
67. THUJA / CUPRESSUS	A	1	41	3	-	-	1	2	-	-	-	-		48	0.57
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
68. TINOSPORA	A	-	-	-	-	-	3	11	2	1	-	-	-	17	0.20
CORDIFOLIA	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
69. TOONA CILIATA	A	-	4	1	-	-	-	-	-	-	-	-	-	5	0.06
	B	2	3	2	-	-	-	-	-	-	-	-	-	7	0 09
70. TYPHA AUSTRALIS	A	-	3	147	101	116	23	11	3	-	1	-	-	405	4.78
	B	-	-	104	53	27	9	10	6	5	-	-	-	217	2.72
71. URTICACEAE /	A	-	2	2	-	-	-	2	-	3	-	-	-	9	0 11
MORACEAE	B	-	-	2	-	-	-	-	-	-	-	-	4	6	0 08
72. XANTHIUM	A	-	-	-	9	1	-	-	6	19	6	-	-	41	0.48
STRUMERIUM	B	-	-	2	2	2	-	-	3	26	1	1	-	37	0.46
UNIDENTIFIED	A	52	51	69	73	59	51	37	35	36	29	26	23	541	6.38
	B	32	22	35	42	30	20	18	25	34	36	30	30	354	4.43
TOTAL GRAINS	A	1568	868	1117	517	350	442	456	813	1071	526	318	424	8470	100
	B	1202	727	622	464	268	290	373	625	1536	682	517	677	7983	100

Typha australis Schum & Thonn. (Pl.10, Fig.105) Grains spheroidal, size small (21 µm), 1-anaporate, exine reticulate.

1990 - 91 Survey : Total number of pollen grains :744

Site A Period of occurrence : Mar - Aug

Maximum occurrence : Apr (368)

Minimum occurrence : Jun (2)

Percentage contribution : 1.82

1991 - 92 Survey : Total number of pollen grains :405

Site A Period of occurrence : Mar - Sept, Nov.

Maximum occurrence : Apr (147)

Minimum occurrence : Nov (1)

Percentage contribution : 4.78

1991 - 92 Survey : Total number of pollen grains :214

Site B Period of occurrence : Apr - Oct

Maximum occurrence : APr (104)

Minimum occurrence : Oct (5)

Percentage contribution : 2.68

1991 Survey : Total number of pollen grains :2915 m^{-3}

Site A Period of occurrence : Mar - Aug

Maximum occurrence : Apr (1567 m^{-3})

Minimum occurrence : Aug (64 m^{-3})

Percentage contribution : 9.11

GYMNOSPERMS

CUPRESSACEAE

Thuja / Cupressus (Pl.11, Fig.110)Grains spheroidal, rather small to size medium (27 - 39 μm), inaperturate exine flecked with granules, grains containing irregularly shaped contents.

1990 - 91 Survey : Total number of pollen grains :8

Site A Period of occurrence : Feb, Apr, Jul

Maximum occurrence : Apr (4)

Minimum occurrence : Jul (1)

Percentage contribution : 0.02

1991 - 92 Survey : Total number of pollen grains :48

Site A Period of occurrence : Feb - Apr, Jul, Aug

Maximum occurrence : Mar (41)

Minimum occurrence : Feb, Jul (1)

Percentage contribution : 0.57

1991 Survey : Total number of pollen grains :155 m^{-3}

Site A Period of occurrence : JAn - Apr, Jun, Nov

Maximum occurrence : Apr (78 m^{-3})

Minimum occurrence : Jun, Nov (7m^{-3})

Percentage contribution : 0.49

GNETACEAE

Ephedra foliata Boiss (Pl.11, Fig.111) Grains ellipsoidal, size rather small (34 X 23 μm), inaperturate, exine psilate with 12-15 ridges.

1990 - 91 Survey : Total number of pollen grains :98

Site A Period of occurrence : Feb - Apr, Jun, Jul.

Maximum occurrence : Apr (42)

Minimum occurrence : Jun (5)

Percentage contribution : 0.24

1991 - 92 Survey : Total number of pollen grains :6

Site A Period of occurrence : Jan - Apr

Maximum occurrence : Jan, Apr (2)

Minimum occurrence : Feb, Mar (1)

Percentage contribution : 0.07

1991 Survey : Total number of pollen grains :56 m^{-3}

Site A Period of occurrence : Jan-Apr, Aug.

Maximum occurrence : Jan (21 m^{-3})

Minimum occurrence : Mar, Apr, Aug (7m^{-3})

Percentage contribution : 0.18

PINACEAE

Pinus roxburghii Sarg. (Pl.11, Fig.109) Grains saccate, body of the grain large in size (51 X 56 μm), sacci 2,furrow one on ventral side, exine of cap apparently reticulate, reticulations on sacci appear as prominent ridges on inner surface.

1990 - 91 Survey : Total number of pollen grains :2690

Site A Period of occurrence : Dec - Jul, Oct

Maximum occurrence : Feb (2217)

Minimum occurrence : Dec (2)

Percentage contribution : 6.58

1991 - 92 Survey : Total number of pollen grains :133

Site A Period of occurrence : Feb - Jun, Sept, Oct, Dec.

Maximum occurrence : Feb (90)

Minimum occurrence : May, Oct, Dec (1)

Percentage contribution : 1.57

1991 - 92 Survey : Total number of pollen grains :30

Site B Period of occurrence : Oct - Dec, Feb, Mar

Maximum occurrence : Feb (15)

Minimum occurrence : Dec (2)

Percentage contribution : 0.38

1991 Survey : Total number of pollen grains :609 m^{-3}

Site A Period of occurrence : Jan - May, Jul, Oct

Maximum occurrence : Feb (362 m^{-3})

Minimum occurrence : Jan, May, Jul, Oct(7m^{-3})

Percentage contribution : 1.90

PTERIDOPHYTES

OLEANDRACEAE

Nephrolepis Schott. (Pl. 12, Fig 117) Spores monolete, bilateral, size 20.4 X 33.8 µm, slightly convex to concave in lateral view and ovate in polar view. Exine smooth, perine with tubercles.

1990-91 Survey : Total number of spores : 21

Site A. Period of occurrence : Nov - Jan

1991-92 Survey : Total number of spores 5

Site A. Period of occurrence = Oct., Dec., Mar., Jul.

1991-92 Survey : Total number of spores = 4

Site B. Period of occurrence = Nov, Jan, Feb.

1991 Survey : Total number of spores = 403 m^{-3}

Site A. Period of occurrence = Sept, Nov. Apr.

SCHIZAEACEAE

Lygodium. Swartz. (Pl 12, Figs. 114, 115) Spores trilete, tetrahedral, size 95X115 μm, amb triangular, angles rounded, sides nearly straight, exine verrucate.

1991-92 Survey : Total number of spores : 1

Site B. Period of occurrence : Dec.

THELYPTERIDACEAE

Christella. Lev. emend. Holtt. (Pl. 12. Fig. 116). Spores monolete, bilateral, size 27.5X36.9 μm, slightly biconvex in lateral view, elliptical in polar view, exine tectate, perine rugulate - papillate.

1990-91 Survey : Total number of spores = 1

Site A. Period of occurrence = Aug.

BRYOPHYTES.

RICCIACEAE

Riccia crystallina L. (Pl 12. Fig. 112) Spores trilete, tetrahedral in shape, size 77X71 µm, amb triangular. exine reticulate with incomplete reticulations.

1990-91 Survey . Total number of spores = 1

Site A. Period of occurrence = Apr.

1991 Survey . Total number of spores = $7m^{-3}$

Sie A. Period of occurrence = Jan.

Riccia frostii. Aust. (Pl. 12. Fig. 113) Spores trilete, tetrahedral, size 45X42 µm, amb triangular, exine with anastomosing ridges.

1990-91 Survey : Total number of spores : 6

Site A. Period of occurrence : Jan, Mar, May, Jun.

1991-92 Survey : Total number of spores : 2.

Site A. Period of occurrence : Jan, Mar.

1991-92 Survey : Total number of spores : 4

Site B. : Period of occurrence : Sept, Feb, Apr.

1991 Survey. :	Total number of spores : 35 m^{-3}
Site A	Period of occurrence : Jan-Apr.

FUNGI

Alternaria Nees (Pl.13, Fig.118) Spores multicellular, muriform, dark, often in acropatal chains.

1990 - 91 Survey :	Total number of spores :13219
Site A	Period of occurrence : Throughout the year
	Maximum occurrence : Apr (4663)
	Minimum occurrence : Nov (130)
	Percentage contribution : 31.07

1991 - 92 Survey :	Total number of spores :9343
Site A	Period of occurrence : throughout the year
	Maximum occurrence : Apr (3228)
	Minimum occurrence : Nov (106)
	Percentage contribution : 38.06

1991 - 92 Survey :	Total number of spores :7739
Site B	Period of occurrence : Throughout the year
	Maximum occurrence : Apr (3245)
	Minimum occurrence : Oct (154)
	Percentage contribution : 32.85

1991 Survey :	Total number of spores :73687 m^{-3}
Site A	Period of occurrence : Throughout the year
	Maximum occurrence : Apr (23596 m^{-3})
	Minimum occurrence : Aug (638 m^{-3})
	Percentage contribution : 18.75

Bipolaris Shoemaker (Pl.13, Fig 121) Spore multicellular, brown in colour, a germ pore is present at each end.

1991 - 92 Survey :	Total number of pollen grains :43
Site A	Period of occurrence : Aug, Nov-Dec
	Maximum occurrence : Nov (20)
	Minimum occurrence : Aug (11)
	Percentage contribution : 0.17

1991 - 92 Survey :	Total number of pollen grains :120
Site B	Period of occurrence : Mar, May-Jan
	Maximum occurrence : Jul (32)
	Minimum occurrence : Jun (2)
	Percentage contribution : 0.50

Bispora Coda (Pl.13, Fig. 122) Spores 2 celled, dark with a thick black septum, occur in clusters or chaines.

1990 - 91 Survey :	Total number of pollen grains :72
Site A	Period of occurrence : Sept-Oct, Dec, Apr
	Maximum occurrence : Oct (36)
	Minimum occurrence : Dec (3)
	Percentage contribution : 0.17

1991 - 92 Survey :	Total number of pollen grains :4
Site A	Period of occurrence : Feb, Apr, Jun
	Maximum occurrence : Apr (2)
	Minimum occurrence : Feb, June(1)
	Percentage contribution : 0.01

1991 - 92 Survey :	Total number of pollen grains :3
Site B	Period of occurrence : Dec
	Maximum occurrence : Dec (3)
	Minimum occurrence : Dec (3)
	Percentage contribution : 0.013

1991 Survey :	Total number of pollen grains :7 m^{-3}
Site A	Period of occurrence : Dec
	Maximum occurrence : Dec (7 m^{-3})
	Minimum occurrence : Dec (7 m^{-3})

Percentage contribution : 0.002

Botryodiplodia Sacc. (Pl.13, Fig.129.) Spores 2 celled, dard brown, with longitudinal striations.

1991 - 92 Survey : Total number of pollen grains :39

Site A Period of occurrence : Apr, Jul - Sept

Maximum occurrence : Aug (21)

Minimum occurrence : Jul (3)

Percentage contribution : 0.158

1991 - 92 Survey : Total number of pollen grains :3

Site B Period of occurrence : May, Dec

Maximum occurrence : Dec (2)

Minimum occurrence : May (1)

Percentage contribution : 0.013

1991 Survey : Total number of pollen grains :70 m^{-3}

Site A Period of occurrence : Jan, Feb, Aug, Oct

Maximum occurrence : Oct (35 m^{-3})

Minimum occurrence : Feb (7 m^{-3})

Percentage contribution : 0.02

Cercospora Fr. ,(Pl.13, Fig.123) Conidia several celled, filiform, hyaline, ending in long appendage with prominent basal scar.

1990 - 91 Survey : Total number of pollen grains :49

Site A Period of occurrence : Oct, Mar-Apr

Maximum occurrence : Mar (39)

Minimum occurrence : Oct (4)

Percentage contribution : 0.12

1991 - 92 Survey : Total number of pollen grains :21

Site A Period of occurrence : Mar-May, Jul, Sep,Dec

Maximum occurrence : Apr (6)

Minimum occurrence : Jul(1)

Percentage contribution : 0.058

1991 - 92 Survey : Total number of pollen grains :121

Site B Period of occurrence : Feb-May, Jul, sep-Oct

Maximum occurrence : Mar (53) Dec-Jan

Minimum occurrence : Sep, Dec (1)

Percentage contribution : 0.51

1991 Survey : Total number of pollen grains :561 m^{-3}

Site A Period of occurrence : Jan - Jun, Aug, Oct

Maximum occurrence : MAr (270 m^{-3})

Minimum occurrence : Aug (7 m^{-3})

Percentage contribution : 0.14

Chaetomium Kunz ex. Fr. (Pl.13, Fig.125) Spores one celled, flattened at one plane, occur in groups, elliptical, dark brown.

1990 - 91 Survey : Total number of spores :543

Site A Period of occurrence : Jun - Oct

Maximum occurrence : Sep (440)

Minimum occurrence : Jul (1)

Percentage contribution : 1.28

1991 - 92 Survey : Total number of pollen grains :81

Site A Period of occurrence : Feb-Mar, May, Nov-Dec

Maximum occurrence : Dec (22)

Minimum occurrence : Nov (7)

Percentage contribution :

1991 - 92 Survey : Total number of pollen grains :322

Site B Period of occurrence : Mar-Oct, Dec

Maximum occurrence : Jul (99)

Minimum occurrence : Jun (2)

Percentage contribution : 1.36

1991 Survey : Total number of pollen grains :14616 m^{-3}

Site A Period of occurrence : Feb-MAy, Sep, Oct

Maximum occurrence : Mar (7624 m^{-3})

Minimum occurrence : Sep (7 m^{-3})

Percentage contribution : 3.72

Cladosporium Link.(Pl.13, Fig.124) Spores 1-2 celled, ovoid or lemon shaped with a characteristic scar.

1990 - 91 Survey : Total number of spores :1018

Site A Period of occurrence : Jul - May

Maximum occurrence : Sep (206)

Minimum occurrence : Aug (6)

Percentage contribution : 2.39

1991 - 92 Survey : Total number of spores :864

Site A Period of occurrence : Throughout the year

Maximum occurrence : Mar (242)

Minimum occurrence : Jun (4)

Percentage contribution : 3.52

1991 - 92 Survey : Total number of spores :1199

Site B Period of occurrence : Aug - May

Maximum occurrence : Jan (682)

Minimum occurrence : Sep (3)

Percentage contribution : 5.09

1991 Survey : Total number of spores :98915 m^{-3}

Site A Period of occurrence : Throughout the yaer

Maximum occurrence : Feb (54915 m^{-3})

Minimum occurrence : Jul, Aug (57 m^{-3})

Percentage contribution : 25.17

Corynespor a Guessow (Pl.13, Fig.127) Sporess several celled, colourless, exospore with a prominent dark basal scar.

1990 - 91 Survey : Total number of spores :216

Site A Period of occurrence : May - Dec, Feb, Mar

Maximum occurrence : Oct (39)

Minimum occurrence : Feb (5)

Percentage contribution : 0.51

1991 - 92 Survey : Total number of spores :83

Site A Period of occurrence : Mar -Dec

Maximum occurrence : Aug (19)

Minimum occurrence : Jun (1)

Percentage contribution : 0.34

1991 - 92 Survey : Total number of spores :101

Site B Period of occurrence : May, Jul-Oct, Dec-Jan

Maximum occurrence : Sep (30)

Minimum occurrence : May (4)

Percentage contribution : 0.42

1991 Survey : Total number of spores :468 m^{-3}

Site A Period of occurrence : Jan-Apr, Jun-Oct

Maximum occurrence : Sep (99 m^{-3})

Minimum occurrence : Jun (14 m^{-3})

Percentage contribution : 0.14

Cur vularia Boed. (Pl.13, Fig.126, 130) Spores 3-5 celled, the second cell largest in size, typically bent.

1990 - 91 Survey : Total number of spores :3982

Site A Period of occurrence : Throught the year

Maximum occurrence : Oct (1132)

Minimum occurrence : Feb (94)

Percentage contribution : 9.36

1991 - 92 Survey :	Total number of spores :1814
Site A	Period of occurrence : Throughout the year
	Maximum occurrence : Oct (370)
	Minimum occurrence : Mar (56)
	Percentage contribution : 7.39

1991 - 92 Survey :	Total number of spores :2207
Site B	Period of occurrence : Throughout the year
	Maximum occurrence : Oct (636)
	Minimum occurrence : Jun (29)
	Percentage contribution : 9.36

1991 Survey :	Total number of spores :34687 m^{-3}
Site A	Period of occurrence : Throughout the yaer
	Maximum occurrence : Oct (15957 m^{-3})
	Minimum occurrence : Nov (362 m^{-3})
	Percentage contribution : 8.83

Dictyoarthrinium Hughes (Pl.13, Fig.128) Spores 4 celled, cross shaped, somewhat square in shape, constricted at septa, thick walled, dark brown.

1990 - 91 Survey :	Total number of spores :8
Site A	Period of occurrence : Jan
	Maximum occurrence : Jan (8)

Minimum occurrence : Jan (8)

Percentage contribution : 0.02

1991 - 92 Survey : Total number of spores :3

Site A Period of occurrence : Feb, Oct

Maximum occurrence : Feb (2)

Minimum occurrence : Oct (1)

Percentage contribution : 0.012

1991 - 92 Survey : Total number of spores :3

Site B Period of occurrence : Dec - Jan

Maximum occurrence : Dec (2)

Minimum occurrence : Jan (1)

Percentage contribution : 0.013

1991 Survey : Total number of spores :176 m^{-3}

Site A Period of occurrence : Feb, Apr, May, Sep - Dec.

Maximum occurrence : Oct (64 m^{-3})

Minimum occurrence : Feb, Apr (7 m^{-3})

Percentage contribution : 0.04

Dreschlera Ito. (Pl.14, Fig.132, 133) Conidia 1-7 septate, light to dark in colour, cylindrical with slightly curved at both ends, lower cell constricted, basal scar prominent.

1990 - 91 Survey : Total number of spores :472

Site A

Period of occurrence : Throughout the year

Maximum occurrence : Jul (93)

Minimum occurrence : Oct (9)

Percentage contribution : 1.11

1991 - 92 Survey : Total number of spores :182

Site A

Period of occurrence : Feb-Dec

Maximum occurrence : Jul (31)

Minimum occurrence : Aug (2)

Percentage contribution : 0.74

1991 - 92 Survey : Total number of spores :285

Site B

Period of occurrence : Throughout the year

Maximum occurrence : Mar (81)

Minimum occurrence : Aug, Oct (3)

Percentage contribution : 1.20

1991 Survey : Total number of spores :1646 m^{-3}

Site A Period of occurrence : Dec-Jul, Sep, Oct

Maximum occurrence : Jan (305 m^{-3})

Minimum occurrence : Feb (43 m^{-3})

Percentage contribution : 0.42

Emericella Berk & Br. (Pl.13, Fig.131) Spores one celled, star shaped, occur in clusters, dark with hyaline arms.

1991 - 92 Survey : Total number of spores :42

Site B Period of occurrence : Dec - Jan

Maximum occurrence : Dec (34)

Minimum occurrence : Jan (8)

Percentage contribution : 0.17

Epicoccum Link. (Pl.14, Fig.136) Spores irregularly septate, brown in colour, globose, subglobose or irregular.

1990 - 91 Survey : Total number of spores :3465

Site A Period of occurrence : Oct - Jul

Maximum occurrence : Apr (1133)

Minimum occurrence : Oct (6)

Percentage contribution : 8.14

1991 - 92 Survey : Total number of spores :2058

Site A Period of occurrence : Throughout the year

Maximum occurrence : Mar (727)

Minimum occurrence : Aug (6)

Percentage contribution : 8.38

1991 - 92 Survey : Total number of spores :1894

Site B Period of occurrence : Throughout the year

Maximum occurrence : Apr (1167)

Minimum occurrence : Sep (2)

Percentage contribution : 8.04

1991 Survey : Total number of spores :23042 m^{-3}

Site A Period of occurrence : Throughout the yaer

Maximum occurrence : Jan (11851 m^{-3})

Minimum occurrence : Nov (43 m^{-3})

Percentage contribution : 5.86

Fusarium Link. (Pl.14, Fig.134) Spores hyaline, macroconidia delicate, sickle shaped, 3-6 septate, curved, tapering at both ends.

1991 - 92 Survey : Total number of spores :29

Site A Period of occurrence : Mar, May

Maximum occurrence : May (28)

Minimum occurrence : Mar (1)

Percentage contribution : 0.118

1991 - 92 Survey : Total number of spores :11

Site B Period of occurrence : Jul - Sep, Dec

Maximum occurrence : Jul, Sep (4)

Minimum occurrence : Aug (1)

Percentage contribution : 0.04

1991 Survey : Total number of spores :794 m^{-3}

Site A Period of occurrence : Feb-Mar, Aug-Sep

Maximum occurrence : Sep (553 m^{-3})

Minimum occurrence : Mar (21 m^{-3})

Percentage contribution : 0.20

Helminthosporium Link. ex. Fr. (Pl.14, Fig.135) Spores several celled, cylindrical, apex rounded with basal scar, several pseudosepta present.

1990 - 91 Survey : Total number of spores :1860

Site A Period of occurrence : Throhout the year

Maximum occurrence : Apr (734)

Minimum occurrence : Dec (18)

Percentage contribution : 4.37

1991 - 92 Survey :	Total number of spores :840
Site A	Period of occurrence : Throughout the year
	Maximum occurrence : Apr (287)
	Minimum occurrence : Nov (9)
	Percentage contribution : 3.42

1991 - 92 Survey :	Total number of spores :575
Site B	Period of occurrence : Throughout the year
	Maximum occurrence : Apr (127)
	Minimum occurrence : Jun (15)
	Percentage contribution : 2.44

1991 Survey :	Total number of spores :5184 m^{-3}
Site A	Period of occurrence : Throughout the yaer
	Maximum occurrence : Sep (1128 m^{-3})
	Minimum occurrence : Nov, Dec (28 m^{-3})
	Percentage contribution : 1.32

Hirudinaria Ces. (Pl.14, Fig.140) Spores V (-) shaped with 2 divergent appendages several celled.

1991 Survey : Total number of spores :50 m^{-3}

Site A Period of occurrence : Sept

Maximum occurrence : Sep (50 m^{-3})

Minimum occurrence : Sep (50 m^{-3})

Percentage contribution : 0.01

Mastigoporium . Riess. (Pl.14, Fig.141) Spores 4 or more celled, with apical appendage, shape cylindrical with rounded to pointed ends, smooth, light coloured.

1990 - 91 Survey : Total number of spores :789

Site A Period of occurrence : Aug - Jan

Maximum occurrence : Oct (175)

Minimum occurrence : Jan, Aug (2)

Percentage contribution : 1.85

1991 - 92 Survey : Total number of spores :221

Site A Period of occurrence : Feb, Jul - Dec

Maximum occurrence : Oct (175)

Minimum occurrence : Feb, Aug (2)

Percentage contribution : 0.90

1991 - 92 Survey : Total number of spores :318

Site B | Period of occurrence : Aug - Feb

Maximum occurrence : Oct (274)

Minimum occurrence : Aug (1)

Percentage contribution : 1.35

1991 Survey : Total number of spores :1063 m^{-3}

Site A | Period of occurrence : Dec-Feb, Jun, Sep, Oct

Maximum occurrence : Oct (596 m^{-3})

Minimum occurrence : Dec, Feb (7 m^{-3})

Percentage contribution : 0.27

Nigrospora Zimm. (Pl.14, Fig.137) Spores 1-celled, globose to subglobose, black and opaque, smooth.

1990 - 91 Survey : Total number of spores :2953

Site A | Period of occurrence : Throughout the year

Maximum occurrence : Sep (914)

Minimum occurrence : Aug (34)

Percentage contribution : 6.94

1991 - 92 Survey : Total number of spores :632

Site A | Period of occurrence : Throughout the year

Maximum occurrence : Oct (131)

Minimum occurrence : Mar (8)

Percentage contribution : 2.57

1991 - 92 Survey : Total number of spores :890

Site B Period of occurrence : Throughout the year

Maximum occurrence : Oct (257)

Minimum occurrence : Jun (4)

Percentage contribution : 3.77

1991 Survey : Total number of spores :9532 m^{-3}

Site A Period of occurrence : Throughout the yaer

Maximum occurrence : Oct (3149 m^{-3})

Minimum occurrence : Aug (199 m^{-3})

Percentage contribution : 2.43

Periconia Tode. ex. Schw. (Pl.14, Fig.138) Spores 1-celled, spherical, thick walled, smooth or rough, echinulate, brown to dark.

1990 - 91 Survey : Total number of spores :819

Site A Period of occurrence : Oct - Aug

Maximum occurrence : Dec (178)

Minimum occurrence : Oct (3)

Percentage contribution : 1.93

1991 - 92 Survey :	Total number of spores :458
Site A	Period of occurrence : Dec - May
	Maximum occurrence : Dec (166)
	Minimum occurrence : Jun (2)
	Percentage contribution : 1.87

1991 - 92 Survey :	Total number of spores :56
Site B	Period of occurrence : Dec - May
	Maximum occurrence : Jan (35)
	Minimum occurrence : Mar (2)
	Percentage contribution : 0.23

1991 Survey :	Total number of spores :922 m^{-3}
Site A	Period of occurrence : Jan-Mar, May, Jun, Sep, Cot.
	Maximum occurrence : Mar (674 m^{-3})
	Minimum occurrence : May, Jun, Sep, Oct (57 m^{-3})
	Percentage contribution : 0.23

Phaeotrichoconis Subram. (Pl.14, Fig.143) Spores 5-8 septate, with a long appendage at the apex, not constricted at septa, 2nd or 3rd cell from base slightly bigger, prominent basal scar, dark brown.

1990 - 91 Survey :	Total number of spores :584
Site A	Period of occurrence : Jan - May, Sep
	Maximum occurrence : Feb (199)
	Minimum occurrence : Sep (6)
	Percentage contribution : 1.37

1991 - 92 Survey :	Total number of spores :103
Site A	Period of occurrence : Dec - May
	Maximum occurrence : Mar (64)
	Minimum occurrence : Feb (6)
	Percentage contribution : 0.42

1991 - 92 Survey :	Total number of spores :177
Site B	Period of occurrence : Jan - May
	Maximum occurrence : Apr (127)
	Minimum occurrence : May (6)
	Percentage contribution : 0.75

1991 Survey :	Total number of spores :446 m^{-3}
Site A	Period of occurrence : Jan - Apr, Jun
	Maximum occurrence : Mar (220 m^{-3})
	Minimum occurrence : Jun (7 m^{-3})
	Percentage contribution : 0.11

Pucciniopsis Wakefield (Pl.14, Fig.14234) Spores 2 celled, ovoid to oblong, constricted at septum, verrucose, dark.

1990 - 91 Survey : Total number of spores :132

Site A Period of occurrence : Aug - Dec, Apr, Jun

Maximum occurrence : Sep (76)

Minimum occurrence : Dec, Apr (3)

Percentage contribution : 0.31

1991 - 92 Survey : Total number of spores :39

Site A Period of occurrence : Apr, Jul - Dec

Maximum occurrence : Aug (21)

Minimum occurrence : Jul (3)

Percentage contribution : 0.15

1991 - 92 Survey : Total number of spores :27

Site B Period of occurrence : Aug - Sept, Jan

Maximum occurrence : Sep (21)

Minimum occurrence : Jan (4)

Percentage contribution : 0.11

1991 Survey : Total number of spores :6313 m^{-3}

Site A Period of occurrence : Feb, Apr, Jun - Sep

Maximum occurrence : Sep (5001 m^{-3})

Minimum occurrence : Jun (7 m^{-3})

Percentage contribution : 1.61

Rust spores (Pl.14, Figs.144, 145) Spores one celled, globose to subglobose, light to dark in colour, smooth.

1990 - 91 Survey : Total number of spores :1241

Site A Period of occurrence : Sep - Jul

Maximum occurrence : Apr (458)

Minimum occurrence : Sep (2)

Percentage contribution : 2.92

1991 - 92 Survey : Total number of spores :394

Site A Period of occurrence : Throughout the year

Maximum occurrence : Mar (178)

Minimum occurrence : Aug (2)

Percentage contribution : 1.60

1991 - 92 Survey : Total number of spores :569

Site B Period of occurrence : Oct - Aug

Maximum occurrence : Apr (291)

Minimum occurrence : Aug (1)

Percentage contribution : 2.41

1991 Survey : Total number of spores :1524 m^{-3}

Site A Period of occurrence : Sep - May, Jul

Maximum occurrence : Mar (539 m^{-3})

Minimum occurrence : Nov (7 m^{-3})

Percentage contribution : 0.39

Smut spores (Pl.15, Fig.146) Spores one celled, round, dark brown to black, smooth or slightly echinulate.

1990 - 91 Survey : Total number of spores :143

Site A Period of occurrence : Sep, Nov - Feb

Maximum occurrence : Jan (73))

Minimum occurrence : Sep, Feb (5)

Percentage contribution : 0.34

1991 - 92 Survey : Total number of spores :179

Site A Period of occurrence : Jul - Apr

Maximum occurrence : Apr (73)

Minimum occurrence : Sep (2)

Percentage contribution : 0.72

1991 - 92 Survey : Total number of spores :631

Site B

Period of occurrence : Throught the year

Maximum occurrence : Apr (173)

Minimum occurrence : Jun (2)

Percentage contribution : 2.67

1991 Survey : Total number of spores :3647 m^{-3}

Site A

Period of occurrence : Throughout the year

Maximum occurrence : Mar (1362 m^{-3})

Minimum occurrence : Aug (21 m^{-3})

Percentage contribution : 0.93

Spegazzinia Sacc. (Pl.15, Fig.147) spores 4 celled, squarish in shape, constricted at septa, smooth, dark.

1990 - 91 Survey : Total number of spores :19

Site A

Period of occurrence : Sep - Jan, Mar, May

Maximum occurrence : Sep (4)

Minimum occurrence : Jan (1)

Percentage contribution : 0.04

1991 - 92 Survey : Total number of spores :6

Site A — Period of occurrence : Feb - Mar, Oct - Nov

Maximum occurrence : Feb, Nov (2)

Minimum occurrence : Mar, Oct (1)

Percentage contribution : 0.02

1991 - 92 Survey : Total number of spores :1

Site B — Period of occurrence : Jan

Maximum occurrence : Jan (1)

Minimum occurrence : Jan (1)

Percentage contribution : 0.004

1991 Survey : Total number of spores :49 m^{-3}

Site A — Period of occurrence : Jan - Mar, Aug

Maximum occurrence : Feb (21 m^{-3})

Minimum occurrence : Jan, Mar, Aug, Oct (7 m^{-3})

Percentage contribution : 0.01

Spondylocladiella Linder. (Pl.15, Fig.148) Spores 3 celled, constricted at septa, oblong, central cell slightly bigger, brown to dark.

1990 - 91 Survey : Total number of spores :41

Site A — Period of occurrence : Sep - Dec, Feb, Mar

Maximum occurrence : Sep (18)

Minimum occurrence : Nov (1)

Percentage contribution : 0.10

1991 - 92 Survey : Total number of spores :52

Site A Period of occurrence : Mar - May, July - Dec

Maximum occurrence : Dec, Nov (1)

Minimum occurrence : May, Nov (1)

Percentage contribution : 0.21

1991 - 92 Survey : Total number of spores :2

Site B Period of occurrence : Apr

Maximum occurrence : Apr (2)

Minimum occurrence : Apr (2)

Percentage contribution : 0.008

1991 Survey : Total number of spores :391 m^{-3}

Site A Period of occurrence : Jan - Mar, Jun, Sept - Oct

Maximum occurrence : Sep (135 m^{-3})

Minimum occurrence : Jun (7 m^{-3})

Percentage contribution : 0.10

Sporidesmium Link. (Pl. 15, Fig. 152) Spores several celled, apical cells smaller in size, obovate, with a flat, basal scar, brown.

1990 - 91 Survey : Total number of spores :23

Site A

Period of occurrence : Oct - Feb

Maximum occurrence : Oct (21)

Minimum occurrence : Feb (2)

Percentage contribution : 0.05

1991 - 92 Survey : Total number of spores :10

Site A

Period of occurrence : Mar, Oct

Maximum occurrence : Oct (9)

Minimum occurrence : Mar (1)

Percentage contribution : 0.04

1991 - 92 Survey : Total number of spores :18

Site B

Period of occurrence : Sep - Oct

Maximum occurrence : Sep (12)

Minimum occurrence : Oct (6)

Percentage contribution : 0.07

1991 Survey : Total number of spores :134 m^{-3}

Site A

Period of occurrence : Jun - Jul, Sep - Oct

Maximum occurrence : Oct (64 m^{-3})

Minimum occurrence : Jul (14 m^{-3})

Percentage contribution : 0.3

Sporormia donot . (Pl. 15, Fig. 149) Spores 3 septate, cylindrical, slightly curved, constricted at septa, showing a tendency to seperate at the septa, dark.

1990 - 91 Survey :	Total number of spores :8
Site A	Period of occurrence : Oct, Dec, Jul
	Maximum occurrence : Jul (4)
	Minimum occurrence : Oct (1)
	Percentage contribution : 0.02

1991 - 92 Survey :	Total number of spores :8
Site A	Period of occurrence : Jun, Aug
	Maximum occurrence : Jun (6)
	Minimum occurrence : Aug (2)
	Percentage contribution : 0.03

1991 - 92 Survey :	Total number of spores :16
Site B	Period of occurrence : Jul - Sep, Dec - Jan
	Maximum occurrence : Jul (6)
	Minimum occurrence : Dec (1)
	Percentage contribution : 0.06

1991 Survey : Total number of spores :177 m^{-3}

Site A Period of occurrence : Jun - Oct

Maximum occurrence : Aug (71 m^{-3})

Minimum occurrence : Oct (7 m^{-3})

Percentage contribution : 0.05

Stachybotrys Corda. (Pl. 15, Fig. 154) Spores one celled, in chains or solitary, ellipsoid, echinulate, brown.

1990 - 91 Survey : Total number of spores :43

Site A Period of occurrence : Mar - Apr, Jul - Aug

Maximum occurrence : Mar (16)

Minimum occurrence : Apr, Aug (6)

Percentage contribution : 0.10

1991 - 92 Survey : Total number of spores :104

Site A Period of occurrence ; Feb -Mar, May, Dec

Maximum occurrence : Dec (36)

Minimum occurrence : May (6)

Percentage contribution : 0.42

1991 - 92 Survey : Total number of spores :69

Site B Period of occurrence : Jan

Maximum occurrence : Jan (69)

Minimum occurrence : Jan (69)

Percentage contribution : 0.29

1991 Survey : Total number of spores :106 m^{-3}

Site A Period of occurrence : Sep - Dec, Jun

Maximum occurrence : Jun (43 m^{-3})

Minimum occurrence : Oct, Nov (7 m^{-3})

Percentage contribution : 0.03

Stemphylium Wallr (Pl. 15, Fig. 150) Spores with several transverse and longitudinal septa, variable in shape, smooth, verrucose or echinulate, dark.

1990 - 91 Survey : Total number of spores :294

Site A Period of occurrence : Oct, Dec, Feb - Aug

Maximum occurrence : Feb (120)

Minimum occurrence : Jun (3)

Percentage contribution : 0.69

1991 - 92 Survey : Total number of spores :145

Site A Period of occurrence : Feb - May

Maximum occurrence : Mar (103)

Minimum occurrence : Feb (6)

Percentage contribution : 0.59

1991 - 92 Survey : Total number of spores :151

Site B Period of occurrence : Jan - Jun

Maximum occurrence : Apr (94)

Minimum occurrence : Jun (2)

Percentage contribution : 0.64

1991 Survey : Total number of spores :659 m^{-3}

Site A Period of occurrence : Dec - Jul, Sep - Oct

Maximum occurrence : Mar (277 m^{-3})

Minimum occurrence : Jun, Jul, Sept, Dec (14 m^{-3})

Percentage contribution : 0.17

Teleutospores (Pl.15, Fig.155) Spores 2 celled, brown.

1991 - 92 Survey : Total number of spores :3

Site A Period of occurrence : Feb, Mar

Maximum occurrence : Feb (2)

Minimum occurrence : Nov (1)

Percentage contribution : 0.012

1991 - 92 Survey : Total number of spores :4

Site B Period of occurrence : MAr, Dec

Maximum occurrence : Mar, Dec (2)

Minimum occurrence : Mar, Dec (2)

Percentage contribution : 0.017

Tetraploa Berk. & Br. (Pl.15, Fig.151) Spores with cross and longitudinal septa, 3-4 divergent septate arms present., dark.

1990 - 91 Survey : Total number of spores :68

Site A Period of occurrence : Sep-Jan, Mar, May-Jul

Maximum occurrence : Dec (17)

Minimum occurrence : Nov (2)

Percentage contribution : 0.1

1991 - 92 Survey : Total number of spores :29

Site A Period of occurrence : Feb - May, Jul, Sep-Dec.

Maximum occurrence : Oct (10)

Minimum occurrence : Apr (1)

Percentage contribution : 0.11

1991 - 92 Survey : Total number of spores :36

Site B Period of occurrence : Apr-Jul, Oct, Dec-Feb

Maximum occurrence : Oct (9)

Minimum occurrence : May, Jul (2)

Percentage contribution : 0.15

1991 Survey :	Total number of spores :126 m^{-3}
Site A	Period of occurrence : Jan - Apr, Jun - Oct
	Maximum occurrence : Sep (28 m^{-3})
	Minimum occurrence : Mar, Apr, Jun, Oct (7 m^{-3})
	Percentage contribution : 0.03

Torula Pers. (Pl.15, Fig.153) Spores one-several celled, in chains, detach readily into segments, dark.

1990 - 91 Survey :	Total number of spores :368
Site A	Period of occurrence : Jul-Dec, Mar-May
	Maximum occurrence : Sep (198)
	Minimum occurrence : May (6)
	Percentage contribution : 0.91

1991 - 92 Survey :	Total number of spores :115
Site A	Period of occurrence : Jul-Dec.
	Maximum occurrence : Dec (36)

Minimum occurrence : Oct (2)

Percentage contribution : 0.46

1991 - 92 Survey : Total number of spores :83

Site B Period of occurrence : Jul-Jan

Maximum occurrence : Aug (30)

Minimum occurrence : Jul, Jan (2)

Percentage contribution : 0.35

1991 Survey : Total number of spores :6155 m^{-3}

Site A Period of occurrence : Mar - Jan

Maximum occurrence : Sep (4468 m^{-3})

Minimum occurrence : May (28 m^{-3})

Percentage contribution : 1.57

Trichoconis Clements. (Pl.15, Fig.156) Spores several celled, elongated, with a long appendage at the tip, 3-5 septate, consticted at septa, light coloured.

1990 - 91 Survey : Total number of spores :42

Site A Period of occurrence : Feb-Mar, May-Jun

Maximum occurrence : May (22)

Minimum occurrence : Mar (3)

Percentage contribution : 0.10

1991 - 92 Survey :	Total number of spores :41
Site A	Period of occurrence : Feb - Jun, Oct, Dec.
	Maximum occurrence : Apr (22)
	Minimum occurrence : Jun, Oct (1)
	Percentage contribution : 0.16

1991 - 92 Survey :	Total number of spores :9
Site B	Period of occurrence : May, Aug, Jan-Feb
	Maximum occurrence : Jan (4)
	Minimum occurrence : Feb, Aug (1)
	Percentage contribution : 0.038

1991 Survey :	Total number of spores :312 m^{-3}
Site A	Period of occurrence : Feb - May, Jul, Oct
	Maximum occurrence : Mar (206 m^{-3})
	Minimum occurrence : May, Jul (7 m^{-3})
	Percentage contribution : 0.08

ALGAE

CYANOPHYTA

Aphanocapsa Nag (Pl. 16. Fig. 162). Colonial, colonies compact, cells spheroidal, embedded in fragments of colourless mucilage, colonies rounded.

Gloeocapsa Kutzing (Pl. 16. Fig. 161) Colonial, colonies with spheroidal cells, each cell embedded in an individual homogenous sheath of mucilage, colonies rounded.

Myxosarcina Printz. (Pl. 16, Fig. 163). Colonial, cells cubical shaped or variously pressed, compact, mucilage present, colonies more of less rounded.

Lyngbya Ag. (Pl. 16. Fig. 160). Filamentous, trichome single in a fine sheath of mucilage, light in colour with empty spaces, filaments are unbranched and without heterocysts.

Scytonema Ag. (Pl. 16. Figs. 158, 159) Filamentous, trichomes in a sheath of mucilage, sheath with lamellations, filaments branched with geminate false branches, heterocysts present.

Incidence of plant and insect fragments in the atmosphere.

A good percentage of plant and insect fragments were also recovered from the atmosphere of Allahabad. Among them hairs, fibres, wood fragments, plant tissue fragments, cuticular fragments, small insects and insect parts, were of most common occurrence. Hairs were of different kinds like single celled hairs with and without basal cell, multicellular, branched and stellate hairs. These were caught in maximum numbers on the slides, followed by cotton fibres which were colourless or coloured, in tangled groups or appearing singly. Other fibres were thin walled and thick walled plant fibres and of these thin walled were recorded more frequently. Tissue fragments were found to occur as group of thin walled parenchymatous cells or thick walled sclerenchymatous cells. Fragments of cuticle with sinuous and straight-walled cells and also with scattered stomata were recovered. Among them cuticular fragments of graminaceous type were found to be more common. A bryophytic leaf was also trapped but it could not attributed to any particular class.

Insects and insect fragments recorded were small insects which were sporadically caught on the slides from time to time. Insect fragments like wing scales were caught in high mumbers, sometimes in groups. Fragments of insect antennae, legs mouth and head parts were recorded as well. (Pls. 17,18 & 19)

CHAPTER - IV

DISCUSSION AND CONCLUSION

DISCUSSION AND CONCLUSION

Day to day monitoring of atmospheric bioelements from - 1990 to 1992 revealed that the atmosphere of Allahabad is constantly contaminated with diverse bioelements viz., pollen grains of angiosperms and gymnosperms, pteridophytes, bryophytes, fungal spores, algal elements , plant and insect fragments and minute insects throughout the year, though in varying frequencies. Pollen grains and fungal spores show daily, monthly, seasonal and annual variations in their concentrations.

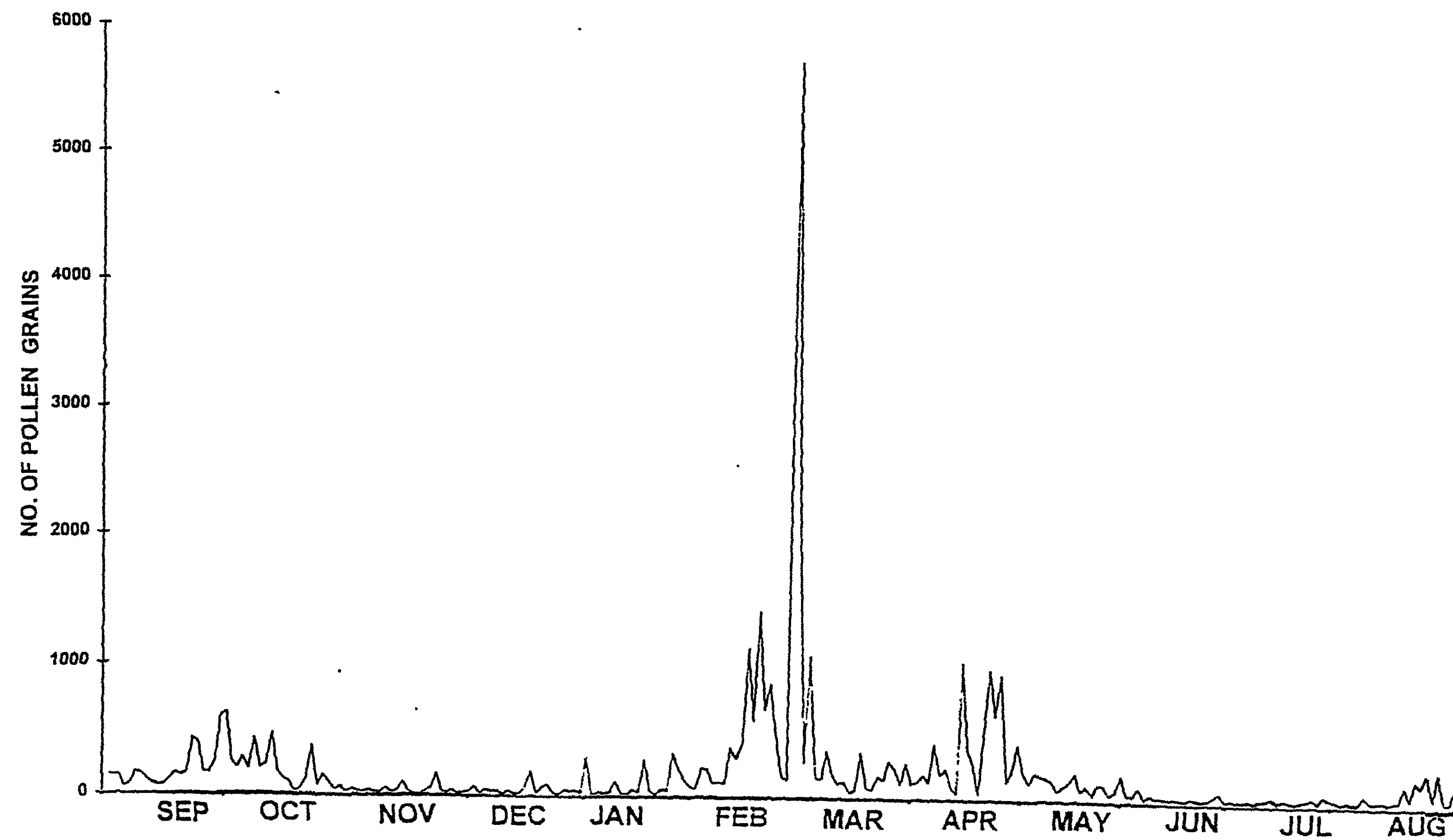
Incidence of airborne pollen grains

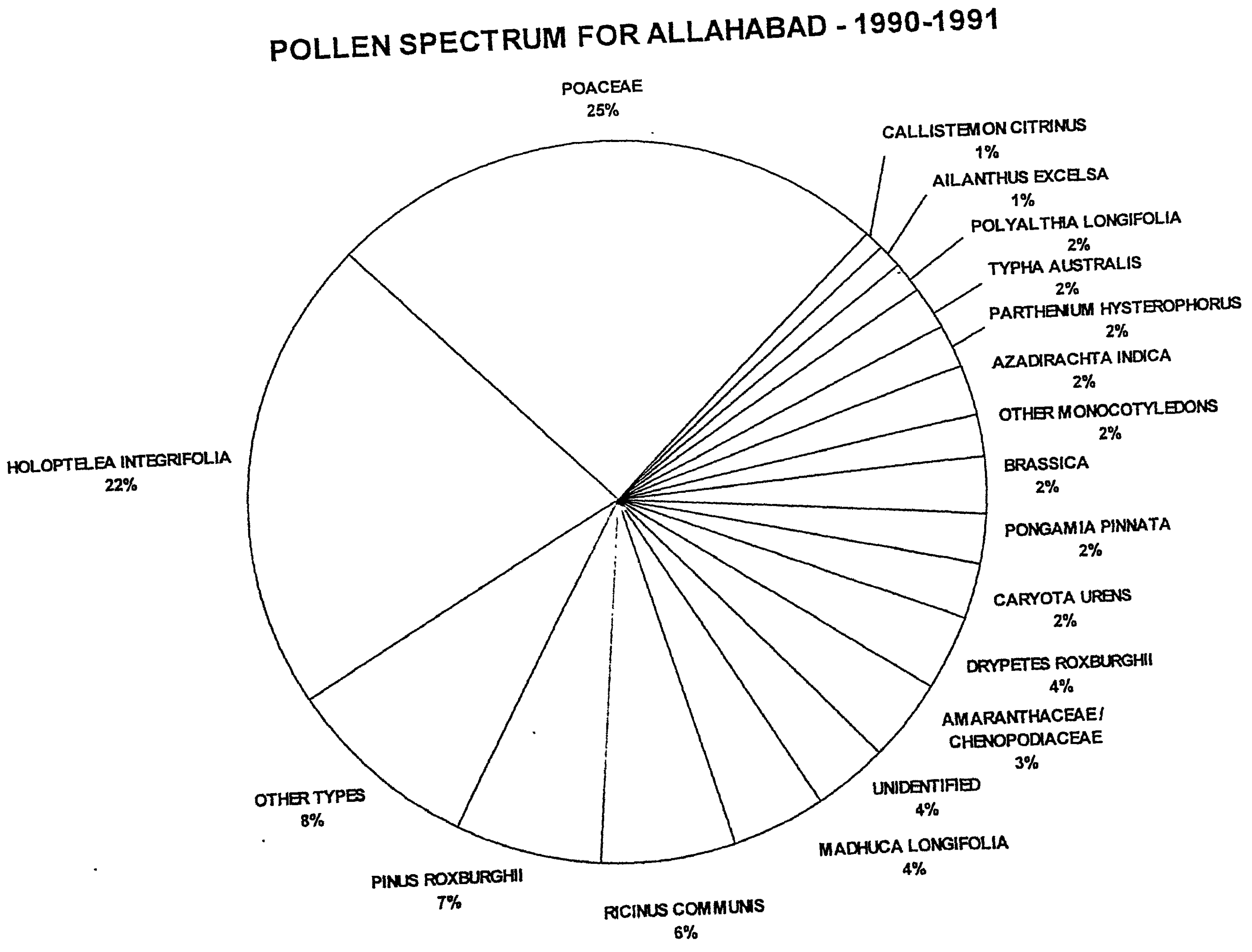
Survey I September 1990 - August 1991 , site A

During the survey conducted at site A, using a Lakhanpal & Nair sampler, from September 1990 to August 1991; a total of 40862 pollen grains were recovered from the atmosphere; belonging to 43 families of angiosperms and 3 families of gymnosperms . Pollen grains of angiosperms contributed 93% to the total catch while those of gymnosperms contributed 7% . Maximum number of pollen grains were trapped during the month of February (15,554 grains) when about 38.06% of the total annual catch was recorded. Month of June recorded minimum catch of 330 pollen grains only (0.81%). After February, monthly catches is descending order were 6333 in April (15.5%). 5682 in October (13.9%), 3423 in March (8.38%), 2648 in September (6.48%), 1908 in January (4.67%), 1770 in May (4.33%), 1084 in December (2.65%), 1030 in November (2.5%), 740 in August (1.81%) and 360 in July (0.88%).(Table-3)

A total of 85 pollen morphotypes were identified from the atmosphere. March recorded the maximum diversity in morphotypes with 58 different taxa followed by April (53), February (43), May (41), December (24),

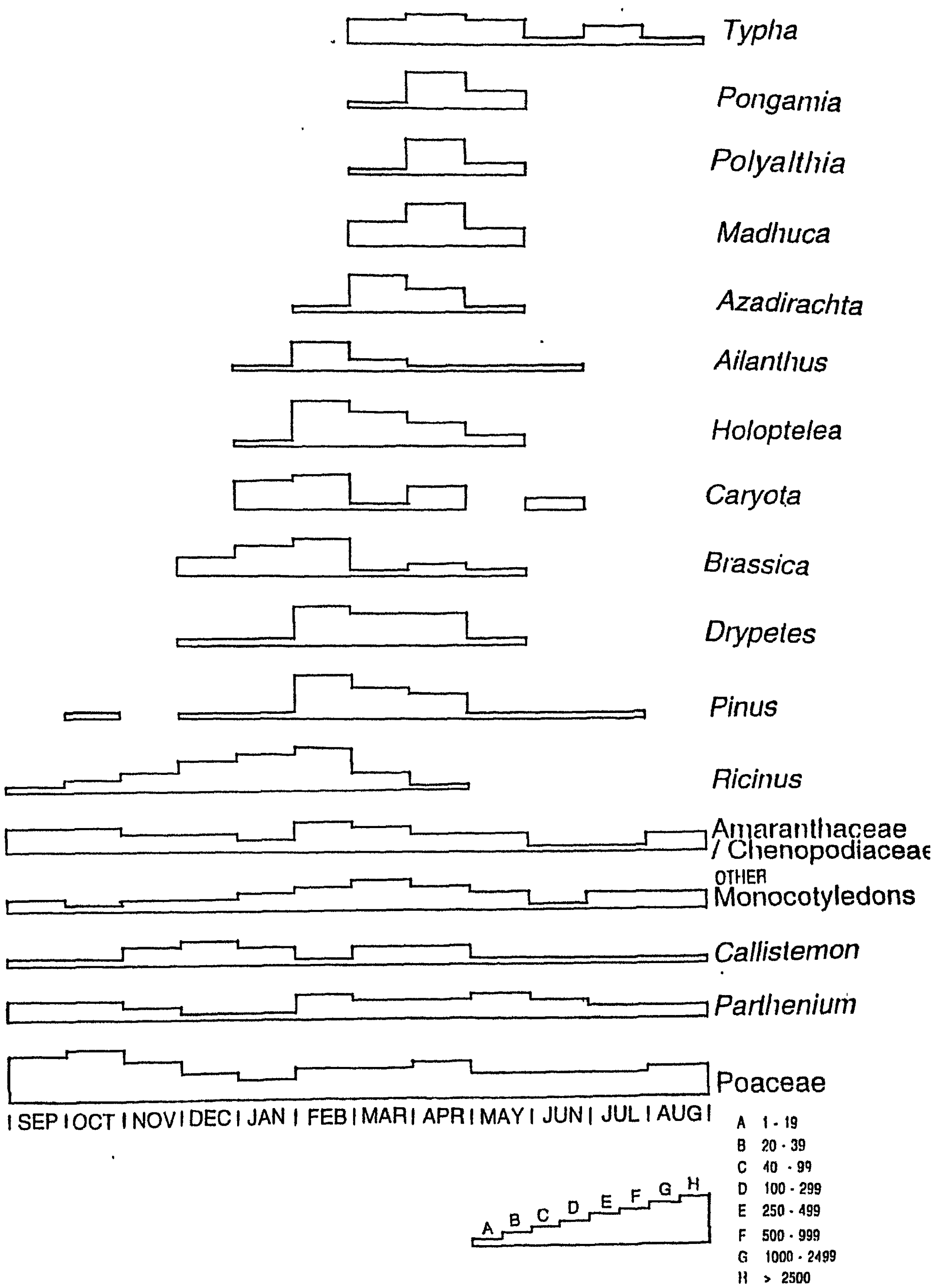
DAILY INCIDENCE OF AIRBORNE POLLEN GRAINS AT ALLAHABAD
DURING 1990 - 1991




POLLEN SPECTRUM FOR ALLAHABAD - 1990-1991
POACEAE 25%
CALLISTEMON CITRINUS 1%
AILANTHUS EXCELSA 1%
POLYALTHIA LONGIFOLIA 2%
TYPHA AUSTRALIS 2%
PARTHENIUM HYSTEROPHORUS 2%
AZADIRACHTA INDICA 2%
OTHER MONOCOTYLEDONS 2%
BRASSICA 2%
PONGAMIA PINNATA 2%
CARYOTA URENS 2%
DRYPETES ROXBURGHII 4%
AMARANTHACEAE / CHENOPODIACEAE 3%
UNIDENTIFIED 4%
MADHUCA LONGIFOLIA 4%
RICINUS COMMUNIS 6%
PINUS ROXBURGHII 7%
OTHER TYPES 8%
HOLOPTELEA INTEGRIFOLIA 22%

Text-fig. 3

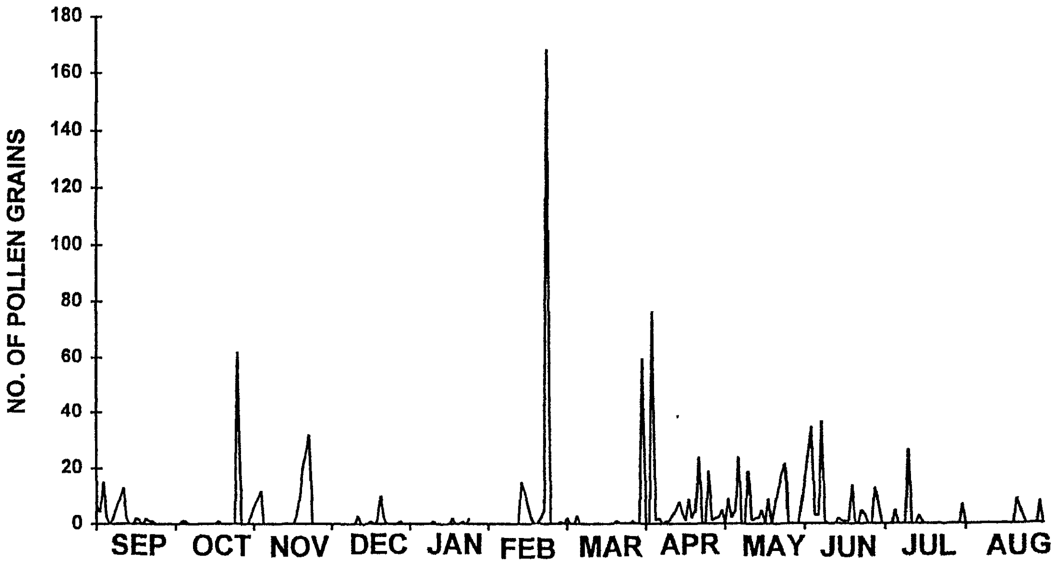
POLLEN CALENDAR FOR ALLAHABAD
1990 - 1991



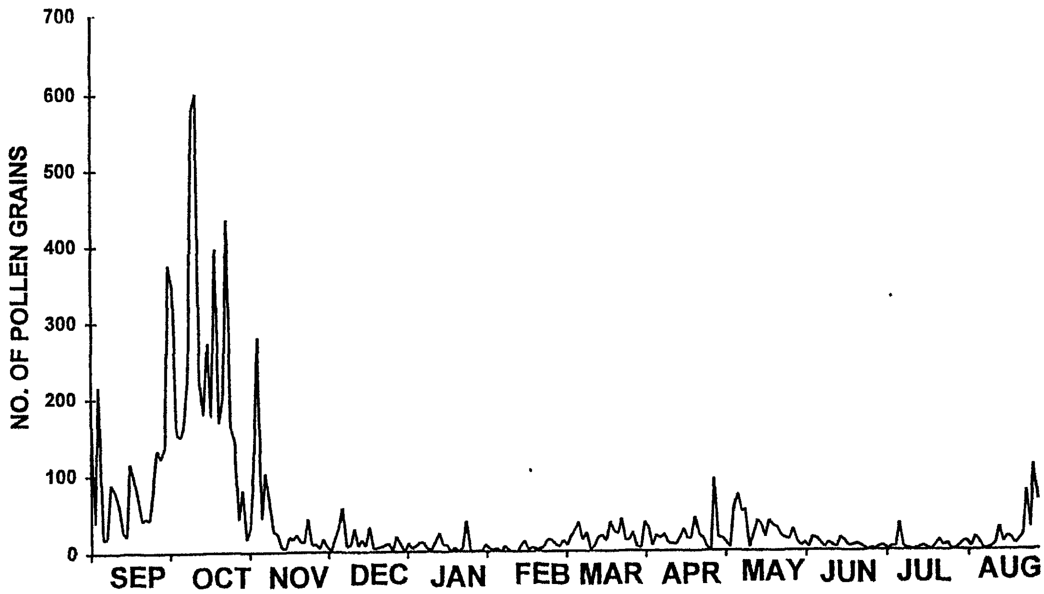
Text-fig. 4

DAILY INCIDENCE OF AIRBORNE POLLEN GRAINS AT ALLAHABAD DURING 1990 - 1991

Parthenium hysterophorus

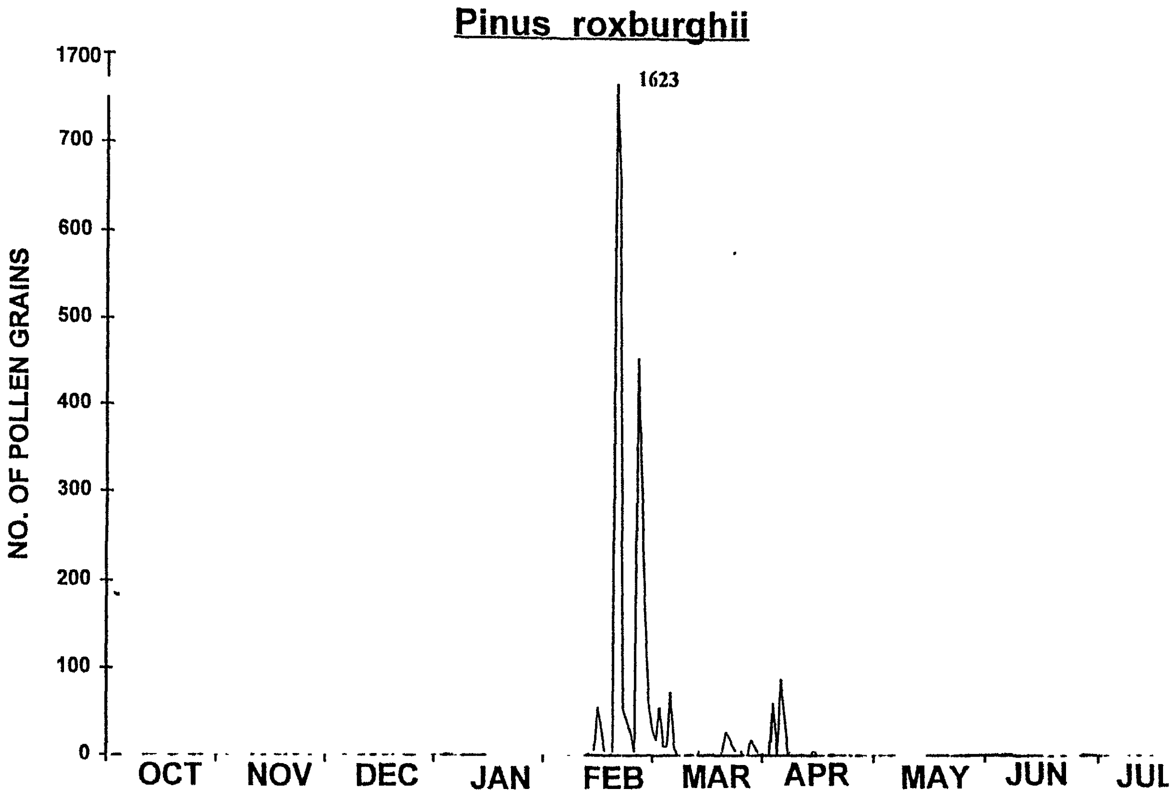


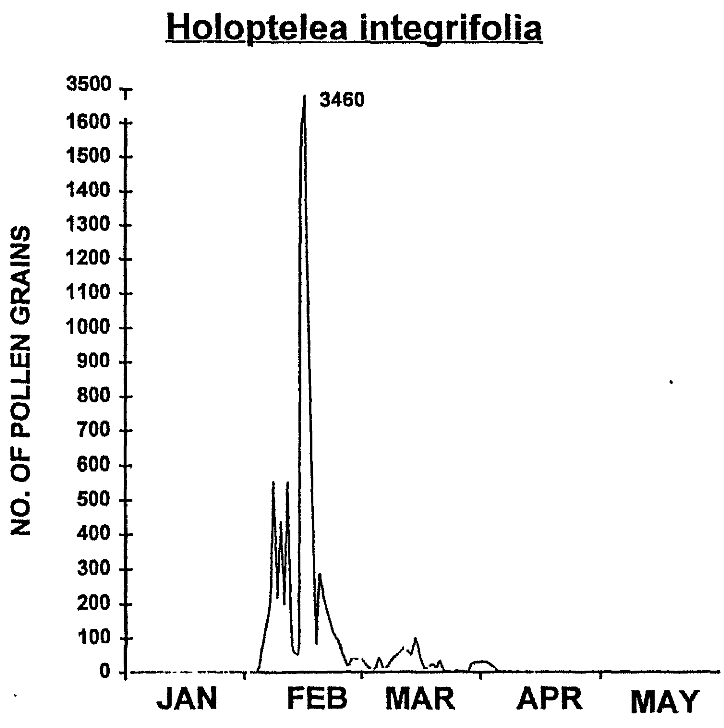
Poaceae



Text-fig 5

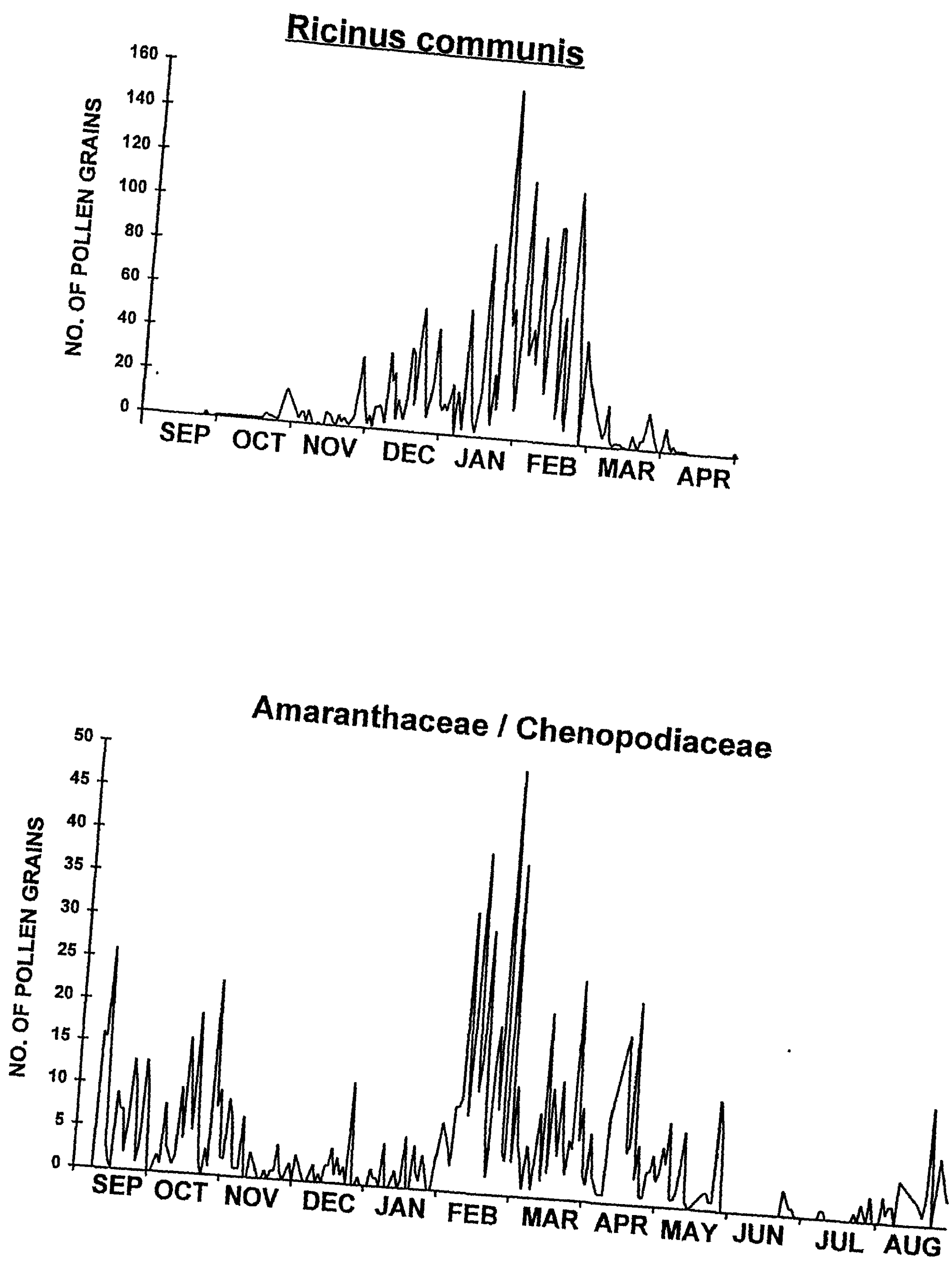
DAILY INCIDENCE OF COMMON POLLEN GRAINS IN THE ATMOSPHERE OF ALLAHABAD DURING 1990 - 1991





Text-fig. 6

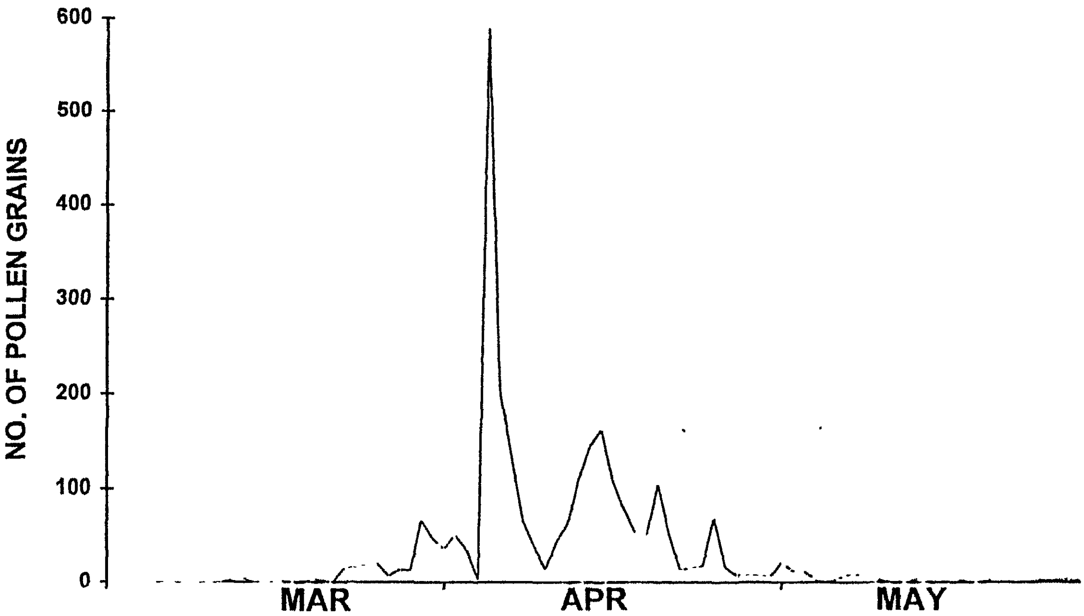
DAILY INCIDENCE OF AIRBORNE POLLEN GRAINS AT ALLAHABAD DURING 1990 - 1991



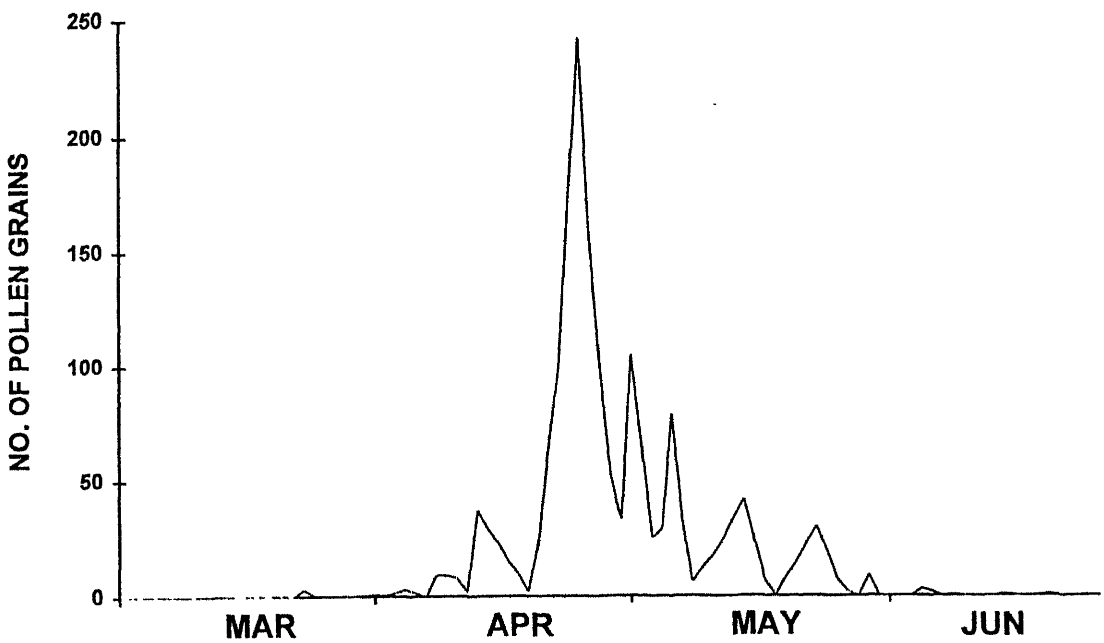
Text-fig. 7

DAILY INCIDENCE OF COMMON POLLEN GRAINS IN THE ATMOSPHERE OF ALLAHABAD DURING 1990 - 1991

Madhuca longifolia



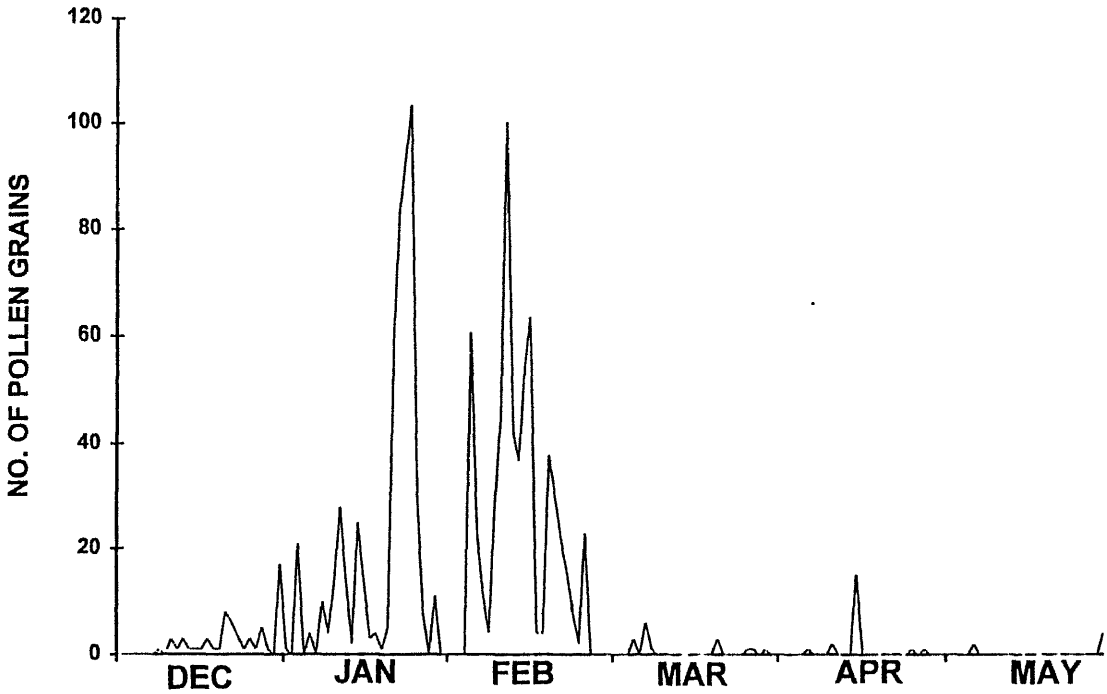
Azadirachta indica



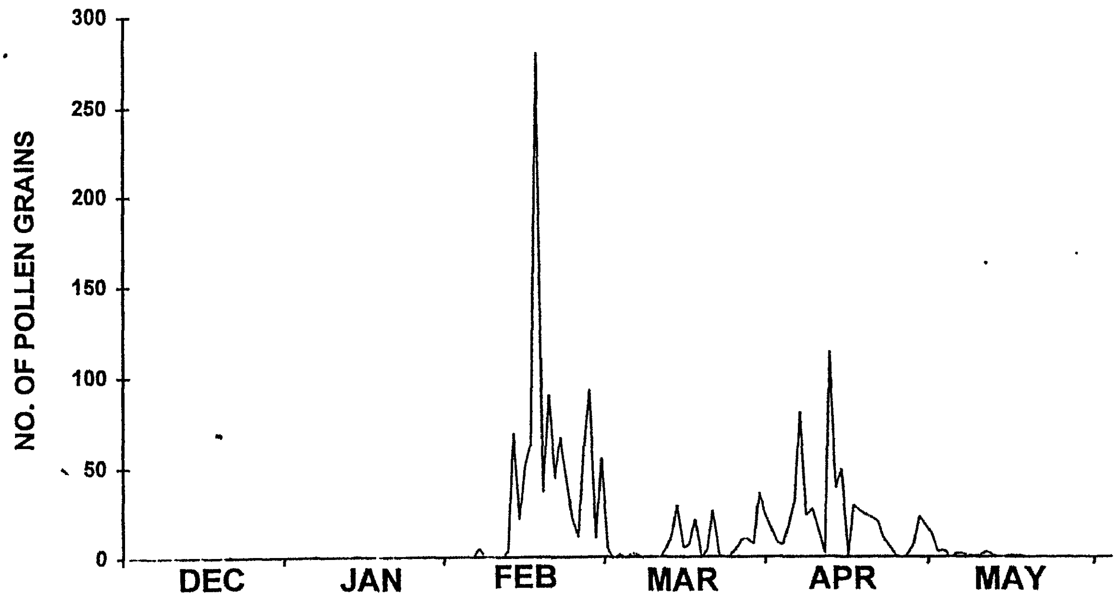
Text-fig. 8

DAILY INCIDENCE OF COMMON POLLEN GRAINS IN THE ATMOSPHERE OF ALLAHABAD DURING 1990 - 1991

Brassica



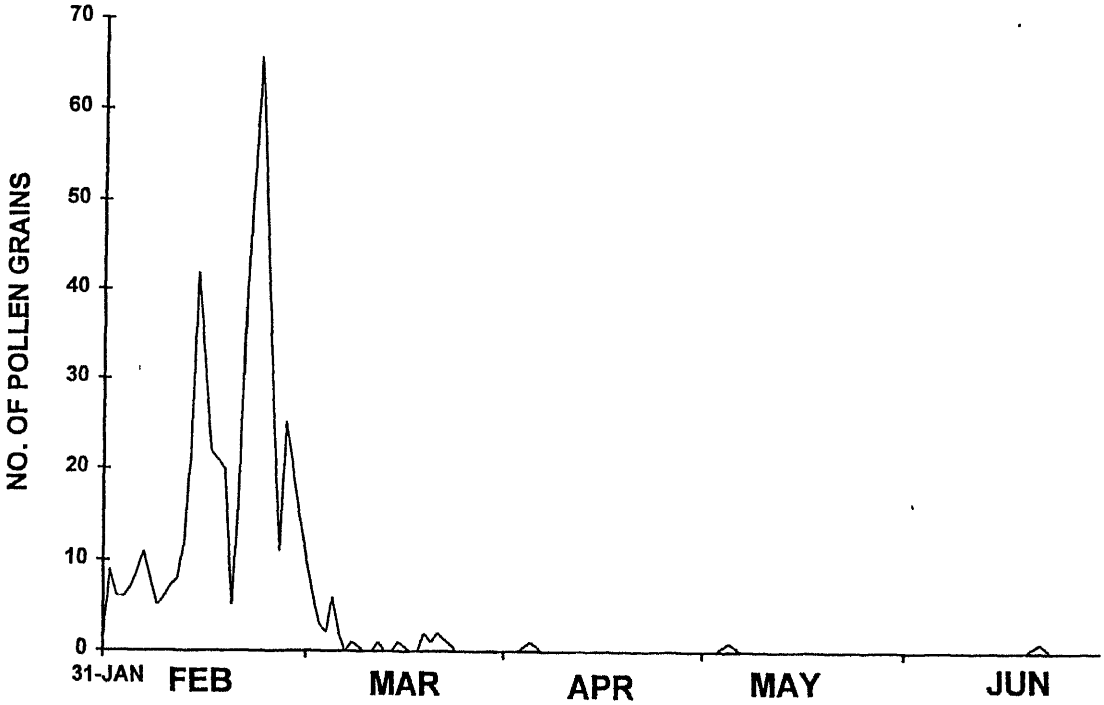
Drypetes roxburghii



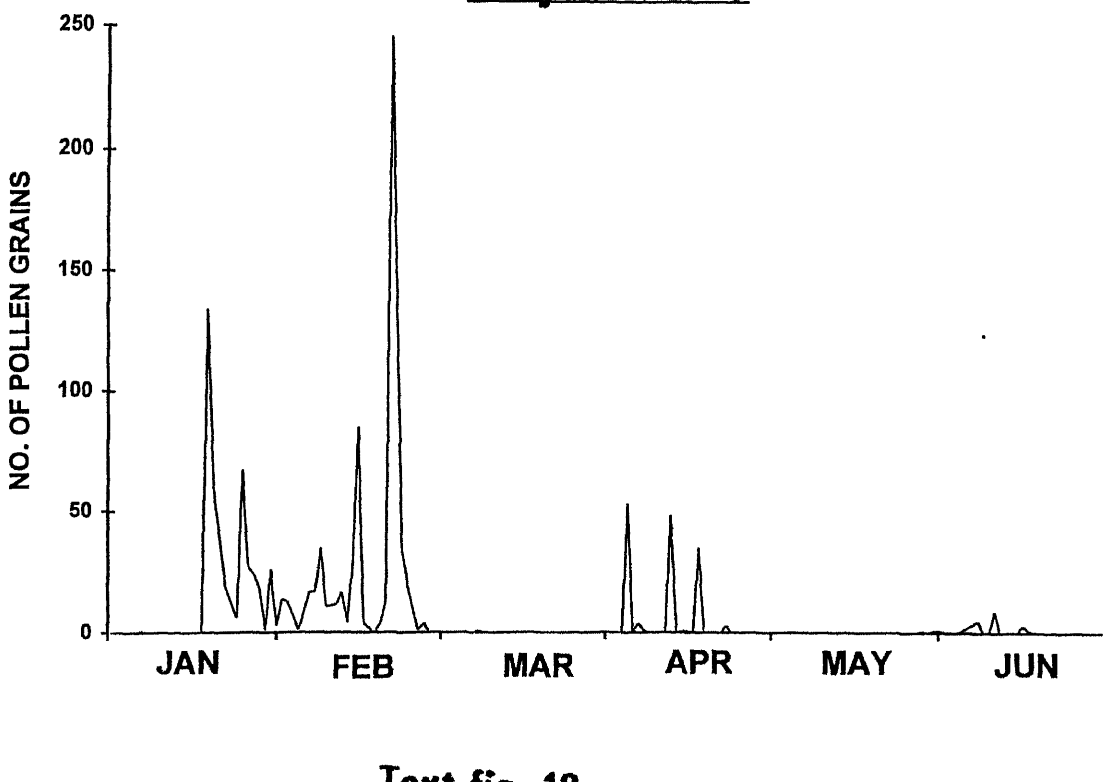
Text-fig. 9

DAILY INCIDENCE OF COMMON POLLEN GRAINS IN THE ATMOSPHERE OF ALLAHABAD DURING 1990 - 1991

Ailanthus excelsa



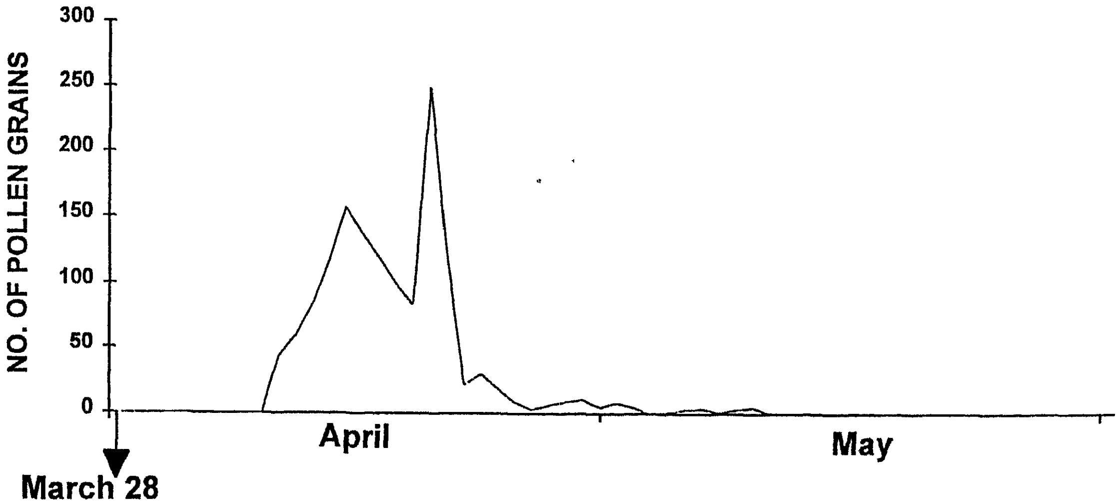
Caryota urens



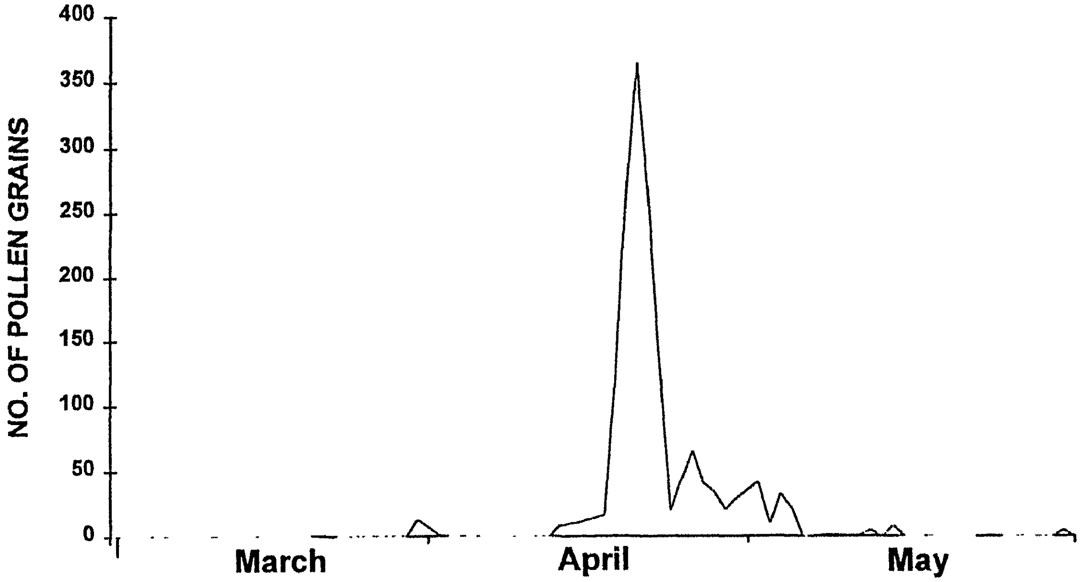
Text-fig. 10

DAILY INCIDENCE OF COMMON POLLEN GRAINS IN THE ATMOSPHERE OF ALLAHABAD DURING 1990 - 1991

Polyalthia longifolia



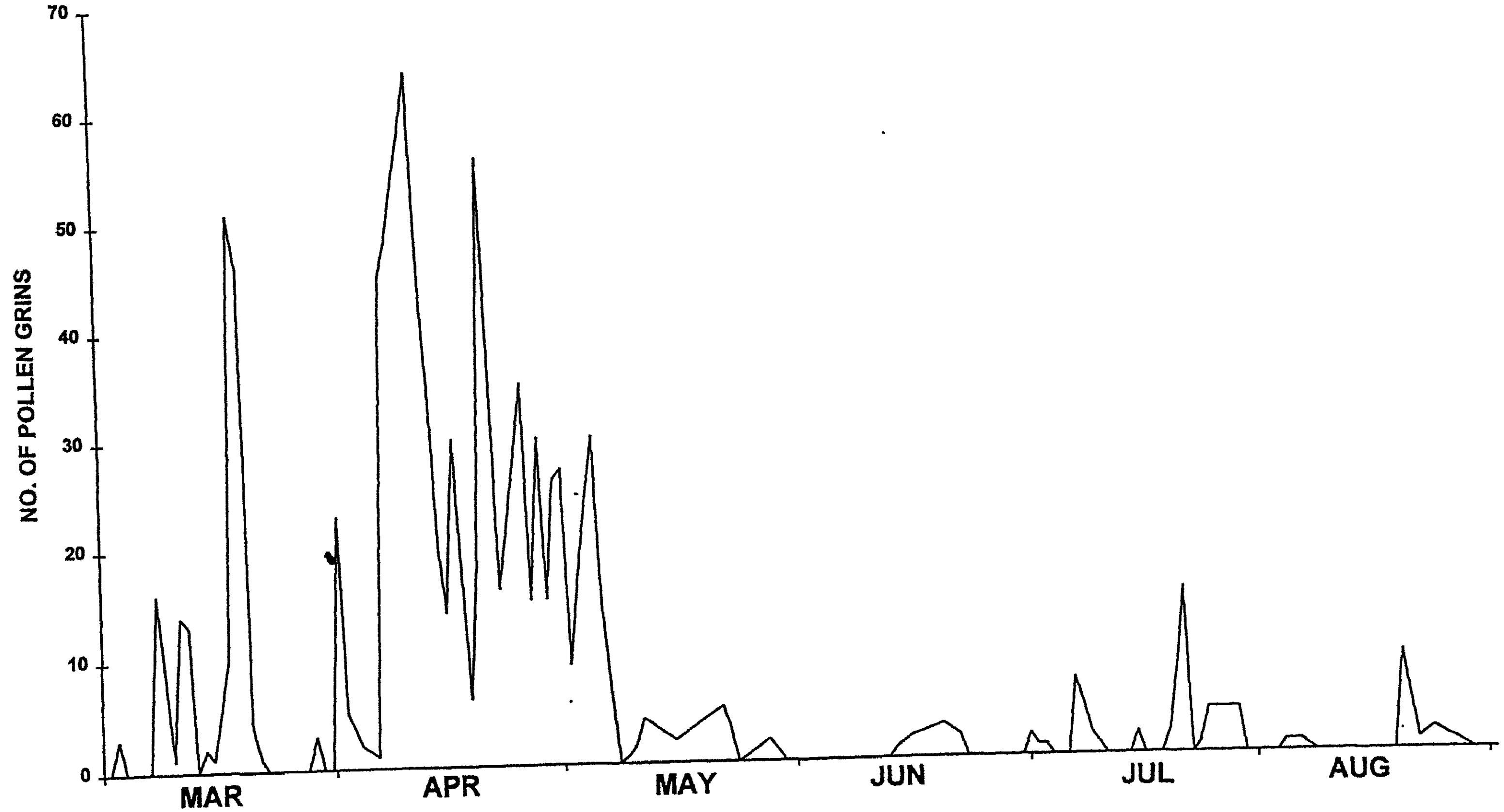
Pongamia pinnata



Text-fig. 11

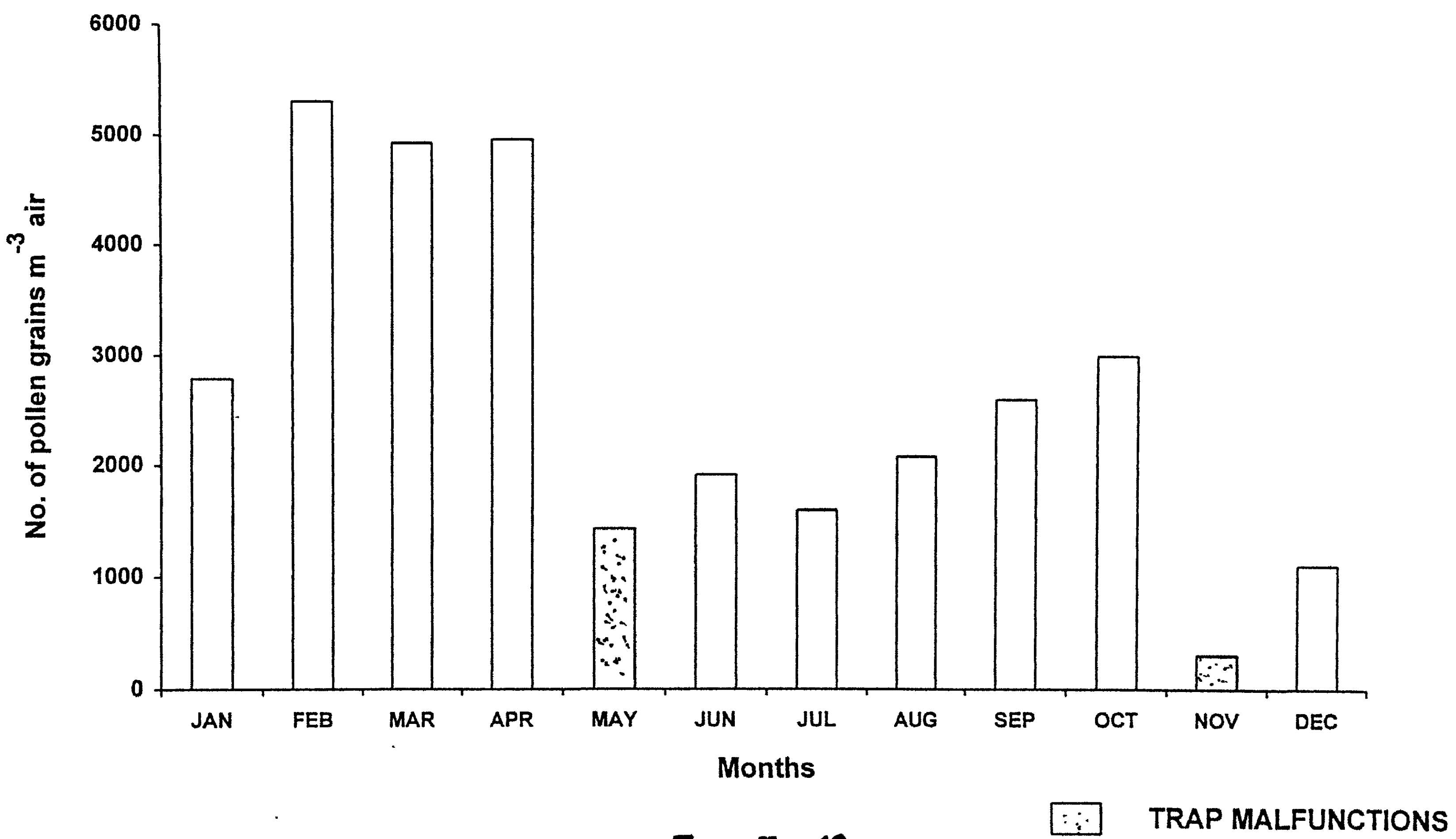
DAILY INCIDENCE OF COMMON POLLEN GRAINS IN THE ATMOSPHERE OF ALLAHABAD
DURING 1990 - 1991

<u>*Typha australis*</u>



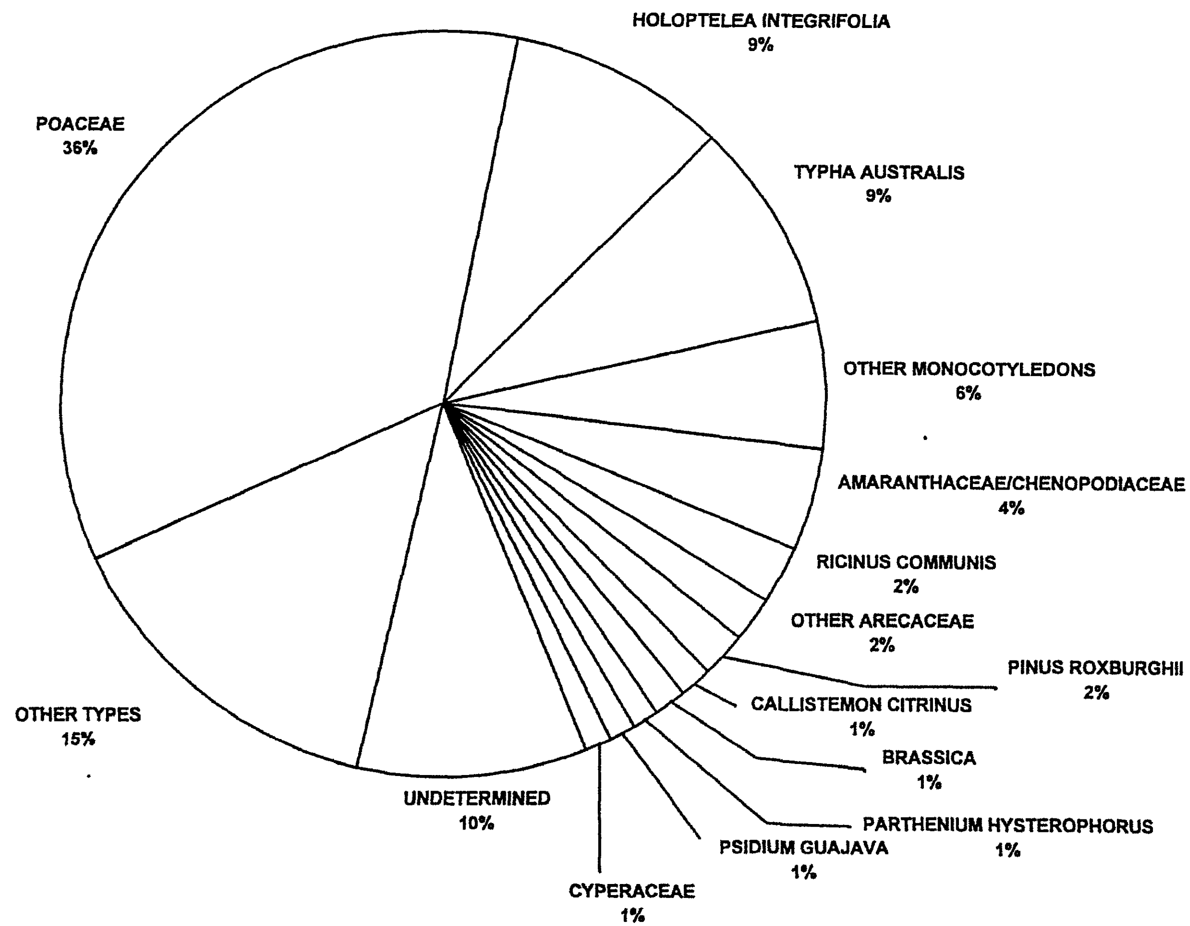
Text-fig. 12

POLLEN INCIDENCE IN THE ATMOSPHERE OF ALLAHABAD DURING 1991



Text-fig. 13

POLLEN SPECTRUM FOR ALLAHABAD
DURING 1991



Text-fig. 14

January (24), June (23), October (22), July (21), September (19) and August showing minimum number of morphotypes (15). Pollen grains of Poaceae and *Holoptelea integrifolia* were found highly dominating, contributing 25.34% and 21.9% to the aeropalynoflora of Allahabad respectively. Next dominant morphotype was *Pinus roxburghii* (6.58%) followed by *Ricinus communis* (5.98%), *Madhuca longifolia* (4.13%), *Drypets roxburghii* (3.54%), Amaranthaceae - Chenopodiaceae (2.77%), *Caryota urens* (2.45%), *Pongamia pinnata* (2.43%), *Brassica* sp. (2.41%) *Azadirachta indica* (2.12%), *Polyalthia longfiolia* (1.6%) Remaining pollen types recorded less than 1% of the total catch (Table 3, Text fig.3).

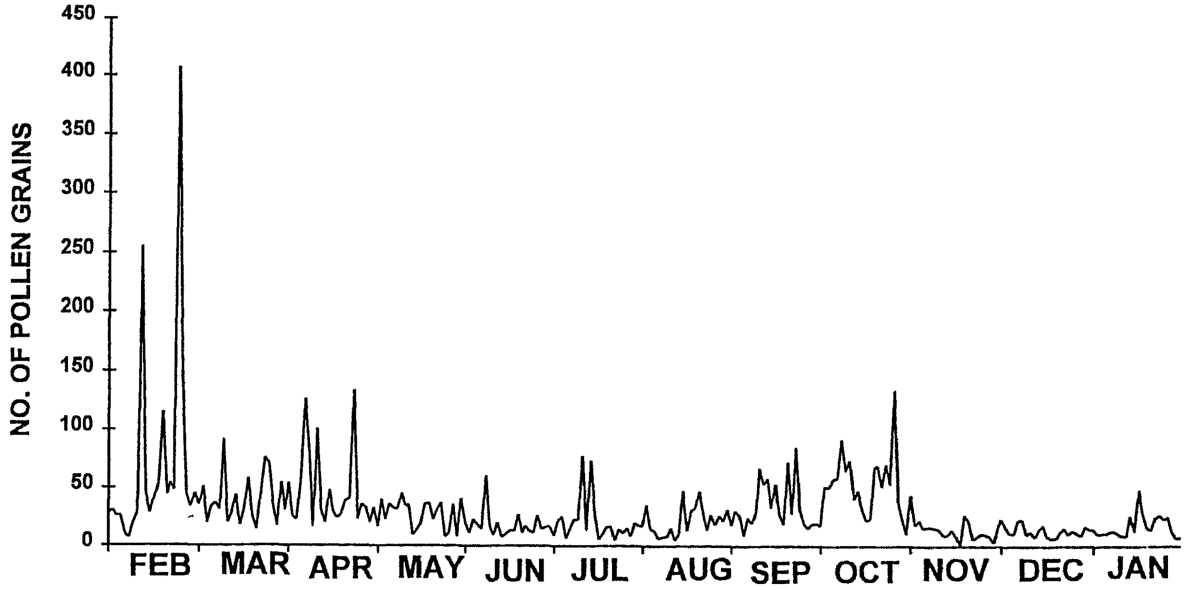
Survey II, January - December 1991 Site A

In the survey conducted with the Burkard volumetric spore trap for a year from January 1991 to December 1991 at Site A; a total catch of 32,048 grains/m^3 were recorded, belonging to 40 angiospermous families and 3 gymmospermous families. Pollen grains of angiosperms contributed 87.0% to the total aeropalynoflora while those of gymnosperms were quite low in occurrence forming only 2.58% of the total catch. Maximum pollen grains were caught from the atmosphere during the month of February (5309 grains/m^3) contributing 16.5% to the total pollen catch (Text fig.13). Pollen catches of other months were 4970 m^{-3} in April (15.47%), 4936 m^{-3} in March (15.35%), 3000 m^{-3} in October (9.33%), 2785 m^{-3} in January (8.74%), 2607 m^{-3} in September (8.08%), 2084 m^{-3} in August (6.52%), 1919m^{-3} in June (5.97%), 1601m^{-3} in July (4.9%), 1431m^{-3} in May (4.55%), 1102m^{-3} in December (3.62%) and the minimum catch of 304m^{-3} grains in November (0.97%).

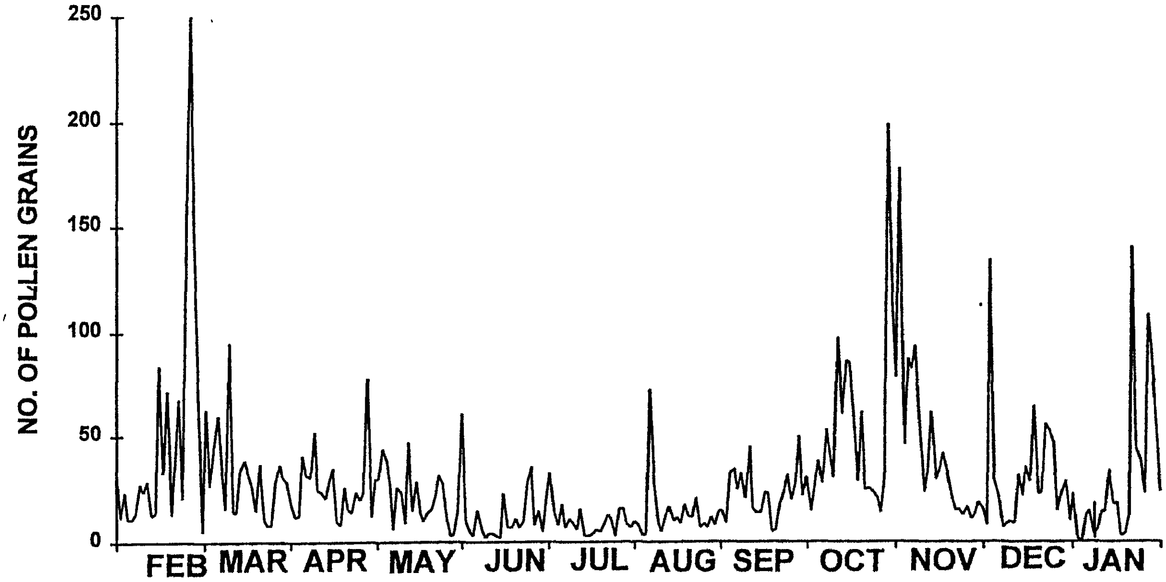
During the present survey 73 pollen morphotypes were identified. March recorded the maximum types of pollen grains (49) followed by April (46) and February (40). Morphotypes recorded in the remaining months of

DAILY INCIDENCE OF AIRBORNE POLLEN GRAINS AT ALLAHABAD DURING 1991 - 1992 AT TWO SITES

SITE A



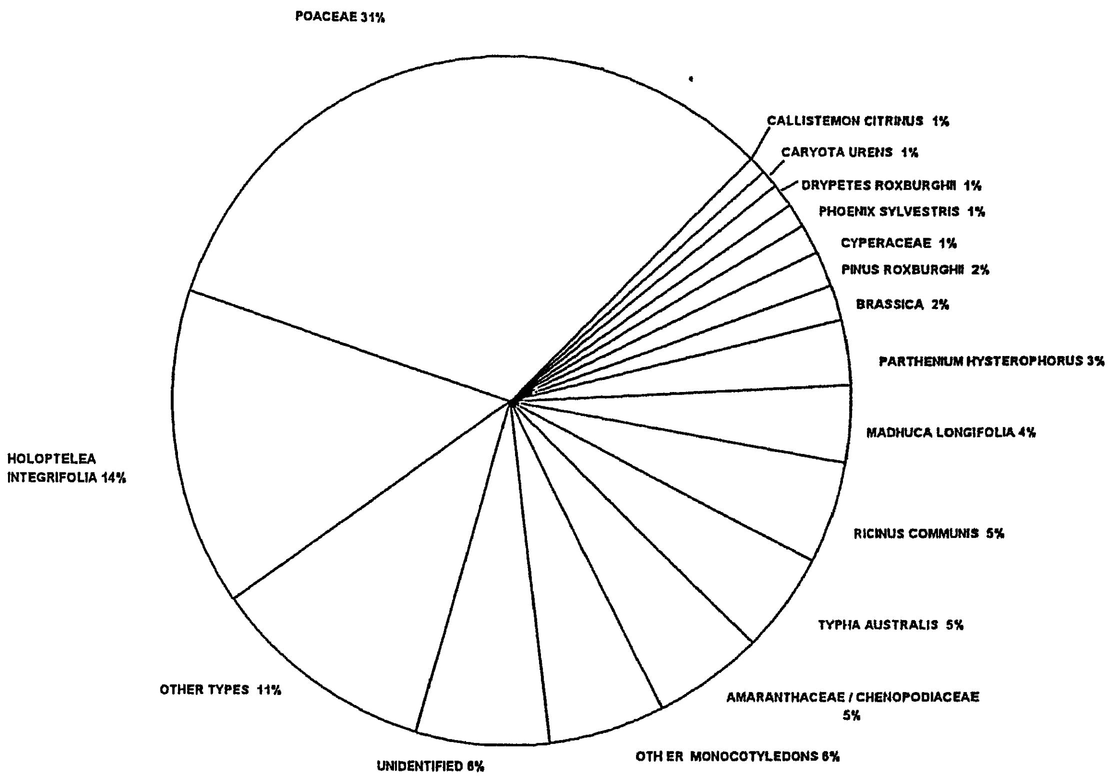
SITE B



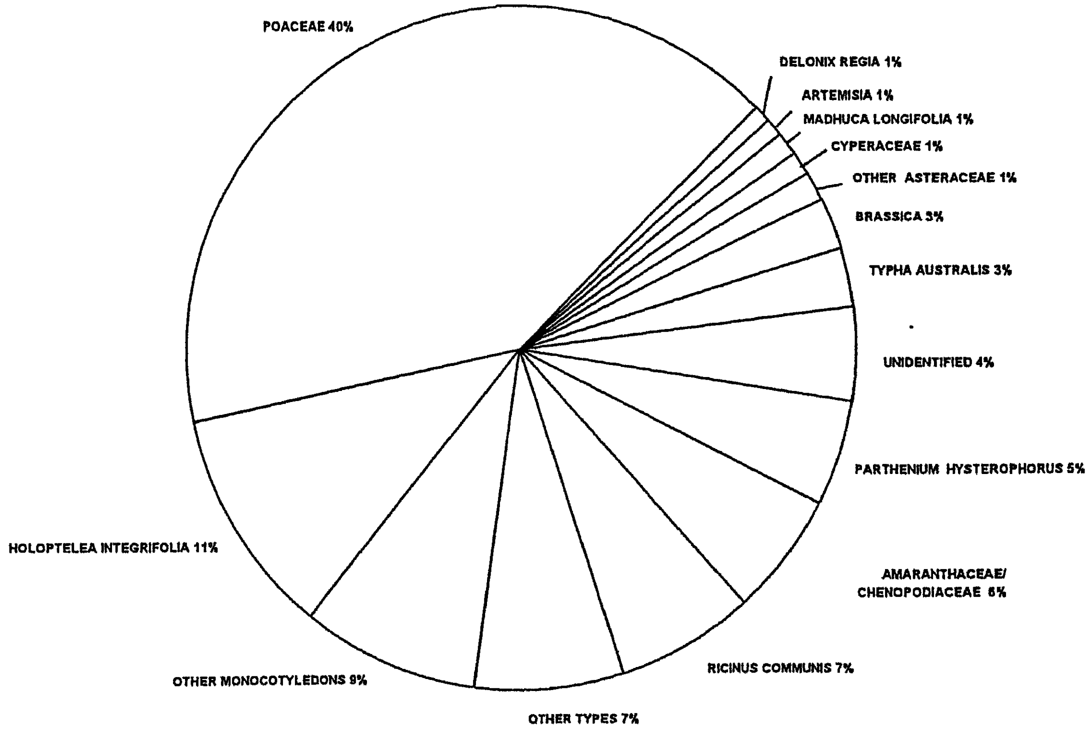
Text-fig. 15

POLLEN SPECTRUM FOR ALLAHABAD - 1991-1992

SITE A



SITE B



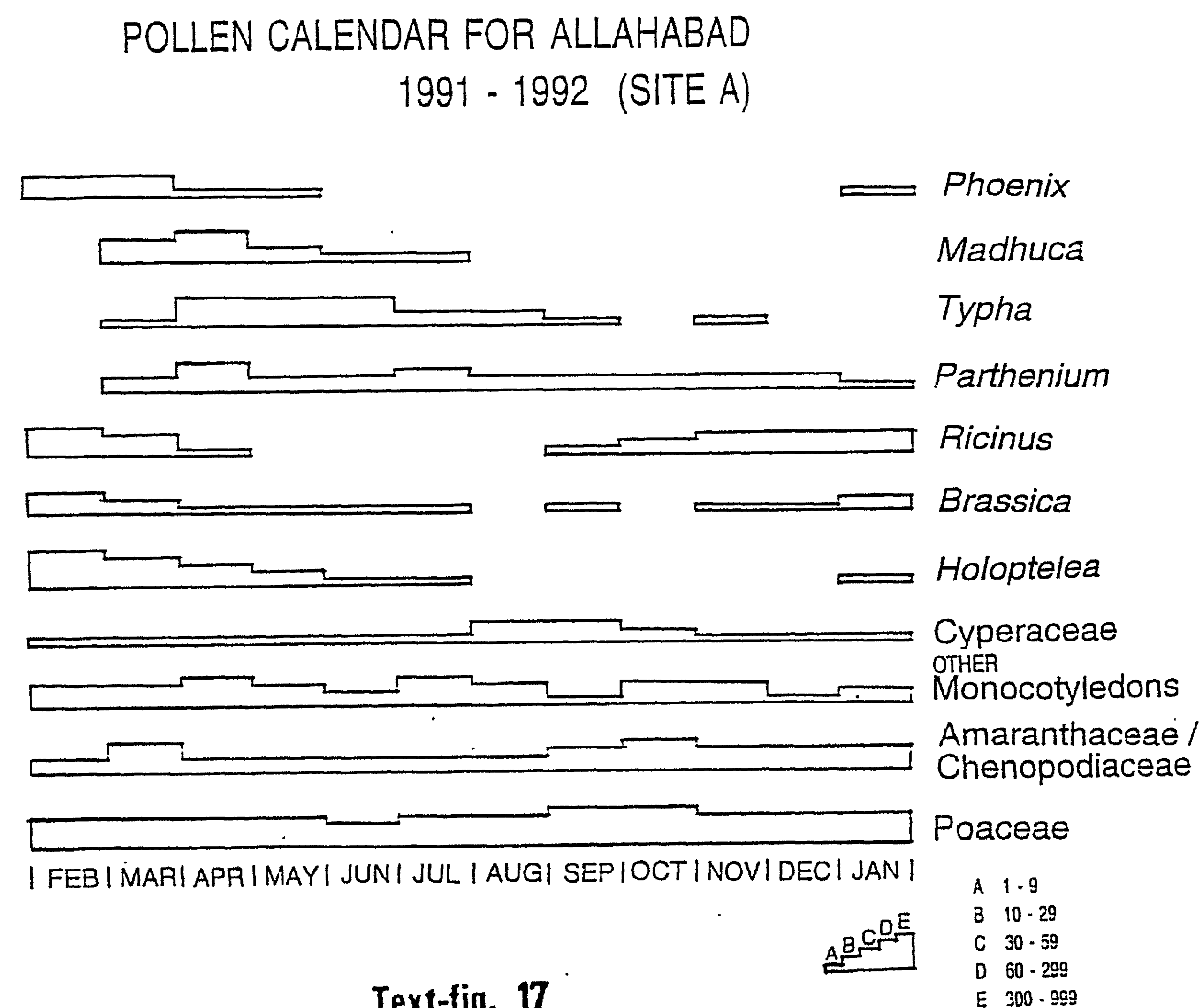
Text-fig. 16

the year were 31 in January , 26 in June, 26 in July,25 in May,18 in September and October, 17 in August, 15 in December and 9 in November. Poaceae contributed the maximum amount of pollen grains (35.02%). The pollen spectrum showeddominance of *Holoptelea integrifolia* (9.18%) followed by *Typha australis* (9.11%). Other pollen morphotypes of common occurence in the air were Amaranthaceae - Chenopodiaceae (4.33%), *Ricinus communis* (2.42%), *Pinus roxburghii* (1.91%), *Callistemon citrinus* (1.37), *Brassica* sp. (1.35%) and Cyperaceae (1.05%), whereas the remaining pollen types recorded a catch of less than 1% (See Table-4,Text fig. 14).

Survey III, February 1991 - January 1992, Site A

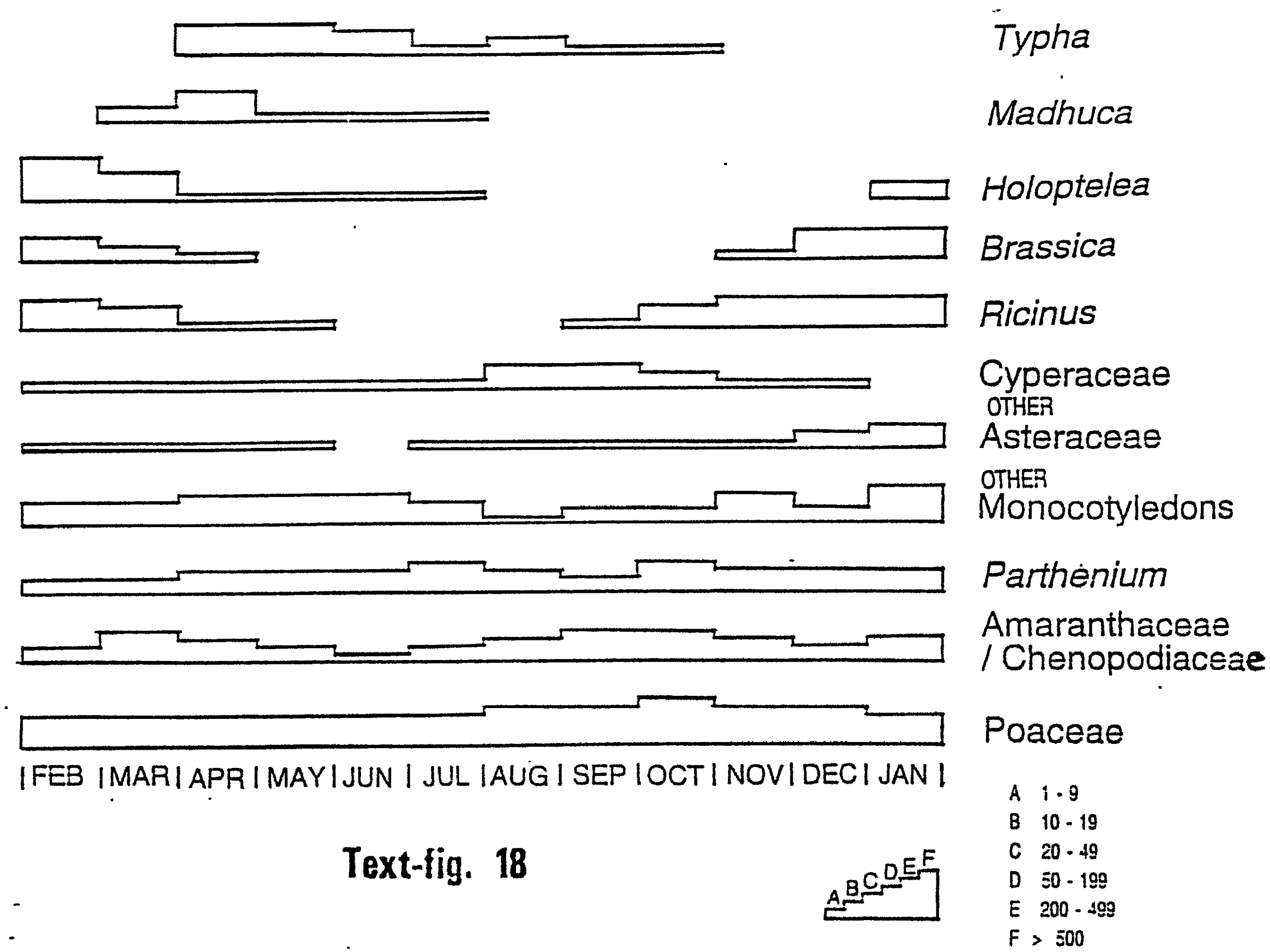
During the survey conducted at site A from February 1991 to January 1992 using a Durham gravity sampler, a total of 8,470 pollen grains were caught belonging to 35 angiospermous families and 3 gymnospermous families. As in other surveys, February recorded the maximum pollen concentration of 1581 grains (18.7%) followed by April with 1117 grains (13.2%) and October with 1071 grains (12.6%). December showed the lowest catch of 308 grains (3.6%). Monthly pollen catch pollen frequency in the other months were 870 in March (10.3%), 813 in September (9.6%), 526 in November (6.2%), 517 in May (6.1%), 456 in August (5.4%), 442 in July (5.2%), 419 in January (4.9%) and 350 in June (4.1%).

Among the 67 pollen morphotypes recorded, April showed the occurrence of 42 types. After April pollen morphotypes recorded in other months were 33 in March, followed by 31 in May, 29 in February, 24 in January, 23 in June & July, 22 in December, 20 in September , 18 in August and 17 in October and November .Pollen grains of Poaceae contributed maximum percentage to the aeropalynoflora (32.4%) followed by *Holoptelea integrifolia* (14.7%). Other common pollen types of the the pollen spectrum were


POLLEN CALENDAR FOR ALLAHABAD
1991 - 1992 (SITE A)
Phoenix
Madhuca
Typha
Parthenium
Ricinus
Brassica
Holoptelea
Cyperaceae
OTHER Monocotyledons
Amaranthaceae / Chenopodiaceae
Poaceae
FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN
A B C D E
A 1 - 9
B 10 - 29
C 30 - 59
D 60 - 299
E 300 - 999

Text-fig. 17

POLLEN CALENDAR FOR ALLAHABAD
1991 - 1992 (SITE B)



Text-fig. 18

Amaranthaceae-Chenopodiaceae (5.1%), *Ricinus communis* (4.8%) *Typha australis* (4.8%), *Madhuca longifolia* (3.6%), *Parthenium hysterophorus* (3%), *Brassica* sp. (1.9%), *Pinus roxburghii* (1.6%), Cyperaceae (1.5%) and *Phoenix sylvestris* (1%) while remaining pollen types recorded less than 1% pollen catch (Table-5, Text fig.16).

Survey IV, February 1991 - January 1992, Site B

From site B altogether 7983 pollen grains were recorded from the atmosphere using a Durham gravity sampler, during the period February 1991 - January 1992. The catch was represented by 33 angiospermous families and only 1 gymnospermous family. Pollen of the former contributed 94% to the total catch while that of the latter only 0.4%. October showed the maximum catch with 1536 (19.2%) while the lowest was in June with 268 (3.4%) grains. After October, next highest pollen catch was recorded in February (1202, 15.1%),followed by March (727, 9.1%), November (682, 8.5%) January (677, 8.5%), September (625, 7.8%), April (622, 7.8%), December (517, 6.5%), May (464, 5.8%), August (373,4.7%) and July (290, 3.6%).

A total of 55 pollen morphotypes were identified of which maximum types were recorded in the months of February and March (30 each) and least in August (10). Morphotypes identified in other months of the year were 27 in May, 22 in December, 20 in February, October & November, 18 in January, 16 in June and 14 in July & September. Among the pollen types recorded, those of Poaceae were found dominating the aeropalynoflora, with 41.2% of the total catch. Next was *Holoptelea integrifolia* with percentage contribution of 10.8%, followed by *Ricinus communis* (6.6%), Amaranthaceae-Chenopodiaceae (5.3%), *Parthenium hysterophorus* (5.2%) *Typha australis* (2.7%), *Brassica* sp. (2.7), Cyperaceae (1.2%), and *Madhuca longifolia* (1.1%). The rest of the pollen morphotypes identified, contributed less

than 1% to the pollen spectrum at Site B (See Table-5,Text fig.16).

Seasonal Periodicity

The trends in the monthly variation of atmospheric pollen grains show presence of two prominent pollen seasons viz. February to May and September to October. These two high frequency pollen seasons alternate with a low frequency and a moderate frequency pollen seasons from June to August and November to January respectively.

February to May (spring to early summer) is a period showing major peak of the year, which occurred in February in all the present 4 surveys (Text figs. 2, 13, 15). During this period about 38% - 66% of the total pollen catch was recorded. There is a rich assemblage of pollen grains mainly belonging to arborescent species apart from those of shrubs, herbs and grasses. Dominant contributors being *Holoptelea integrifolia*, *Pinus roxburghii*, *Ricinus communis*, *Madhuca longifolia*, Poaceae, *Drypetes roxburghii*, Amaranthaceae - Chenopodiaceae, *Caryota urens*, *Pongamia pinnata*, *Brassica* sp.,*Azadirachta indica*, *Parthenium hysterophorus* and *Typha australis*. The arboreal species represented in these months can be grouped into two categories :

1- Those attaining peak in February viz, *Holoptelea integrifolia*, *Pinus roxburghii*, *Ailanthus excelsa*, *Drypetes roxburghii* and *Caryota urens*.(Text Figs. 6, 9, 10)

2- Those attaining peak in April viz, *Azadirachta indica*, *Madhuca longifolia*, *Polyalthia longifolia* and *Pongamia pinnata*(Text figs. 8, 11). The peak period of occurrence of pollen in the air can be correlated with their flowering periods. The trees of former category flower from mid January to March and those of the latter category from March to May.

Besides these other major pollen contributors of arboreal species present in the air were *Callistemon citrinus*, *Delonix regia*, *Emblica officinalis*, *Eucalyptus sp.*, *Morus alba*, *Prosopis juliflora*, *Phoenix sylvestris*, *Pterospermum acerifolium*, *Roystonea regia*, *Syzygium cumini* and *Toona ciliata*.

Pollen grains of shrubs like *Ricinus communis* and *Ephedra foliata* and herbs like *Brassica sp., Iberis amara, Typha australis, Xanthium strumerium* and members of other Monocotyledons were also found in their peak concentrations during this period (Text figs. 7, 9, 12).

Pollen of Poaceae and Amaranthaceae - Chenopodiaceae were trapped throughout the year and showed one of their peaks during this period(Text fig. 5). Those of *Parthenium hysterophorus* too were recorded round the year but they do not show any definite trend of peak occurrence(Text fig. 5).

Other species present though in less numbers were *Alnus sp., Aegle marmelos, Alternanthera sessilis, Argemone mexicana, Artemisia sp., Bombax ceiba, Borassus flabellifer, Bauhinia purpurea, Cajanas cajan, Cannabis sativa, Cassia* spp., *Casuarina equisetifolia, Celosia cristata, Convolvulus prostatus, Coriandrum sativum, Coronopus didynamus, Croton bonplandianum, Feronia limonia, Gnaphalium sp., Justicia sp., Lathyrus odoratus, Mangifera indica, Milletia peguensis, Mirabilis jalapa, Murraya koenigii, Ocimum sanctum, Phlox drummondii, Pithecelobium dulce, Polygonum plebeium, Portulaca sp., Rorippa dubia, Rumex dentatus, Samanea saman, Spathodea sp., Spergula fallax, Strychnos nux vomica, Terminalia arjuna, Thespesia sp., Thuja/ Cupressus, Tinospora cordifolia* and some members of Apiaceae, Araceae, Asteraceae, Acanthaceae, Cyperaceae, Malvaceae, Urticaceae/ Moraceae and Rutaceae- (Tables 3, 4, 5).

June to August (late summer to monsoon) is a low frequency period due to the end of the flowering of the arboreal taxa.(Text figs. 2, 13, 15) Percentage contribution of pollen in this period was 3% - 17% . From May onwards there is a gradual decrease in airborne pollen counts reaching minimum in the month of June. However in two surveys, during January - December 1991 (B S T)and Durham gravity survey 1991-1992 at site A, the lowest frequency was

recorded in December. The taxa contributing pollen to the atmosphere in this period were *Acacia nilotia, Aegle marmelos,* Amaranthaceae - Chenopodiaceae, *Caryota urens,* Cyperaceae, *Parthenium hysterophorus,* Poaceae, *Typha australis and* members of Monocotyledons. Other types present during this period, although in very low frequencies were *Ailanthus excelsa, Alnus sp., Alternanthera sessilis, Artemisia sp., Azadirachta indica, Barringtonia acutangula, Borassus flabellifer, Brassica* sp., *Callistemon citrinus, Cannabis sativa, Cassia* spp., *Coriandrum sativum, Croton bonplandianum, Drypetes roxburghii, Emblica officinalis, Ephedra foliata, Feronia limonia, Gnaphalium* sp., *Gomphrena globosa, Holoptelea integrifolia, Madhuca longifolia, Morus alba, Peltophorum pterocarpum, Pinus roxburghii, Polyalthia longifolia, Polygonum plebeium, Pongamia pinnata, Psidium guajava, Ricinus communis, Tamarindus indica, Terminalia arjuna, Thuja / Cupressus, Tinospora cordifolia, Xanthium strumerium* and some members of Acanthaceae, Asteraceae, Malvaceae, Urticaceae/ Moraceae.

From June onwards there is a slight increase in the pollen counts due to the increase in the pollen grains of grasses, sedges and herbs belonging to families Amaranthaceae/Chenopodiaceae.

September to October (post monsoon) is the second high frequency pollen season which is due to the flowering of the post monsoon weeds and grasses(Text fig 2, 13, 14). This period contributed 17% - 27% aerial pollen to the total aeropalynoflora. The dominant contributor was family Poaceae, showing its major peak in October. Upto 69% of the annual catch of Poaceae pollen was recorded during this period.

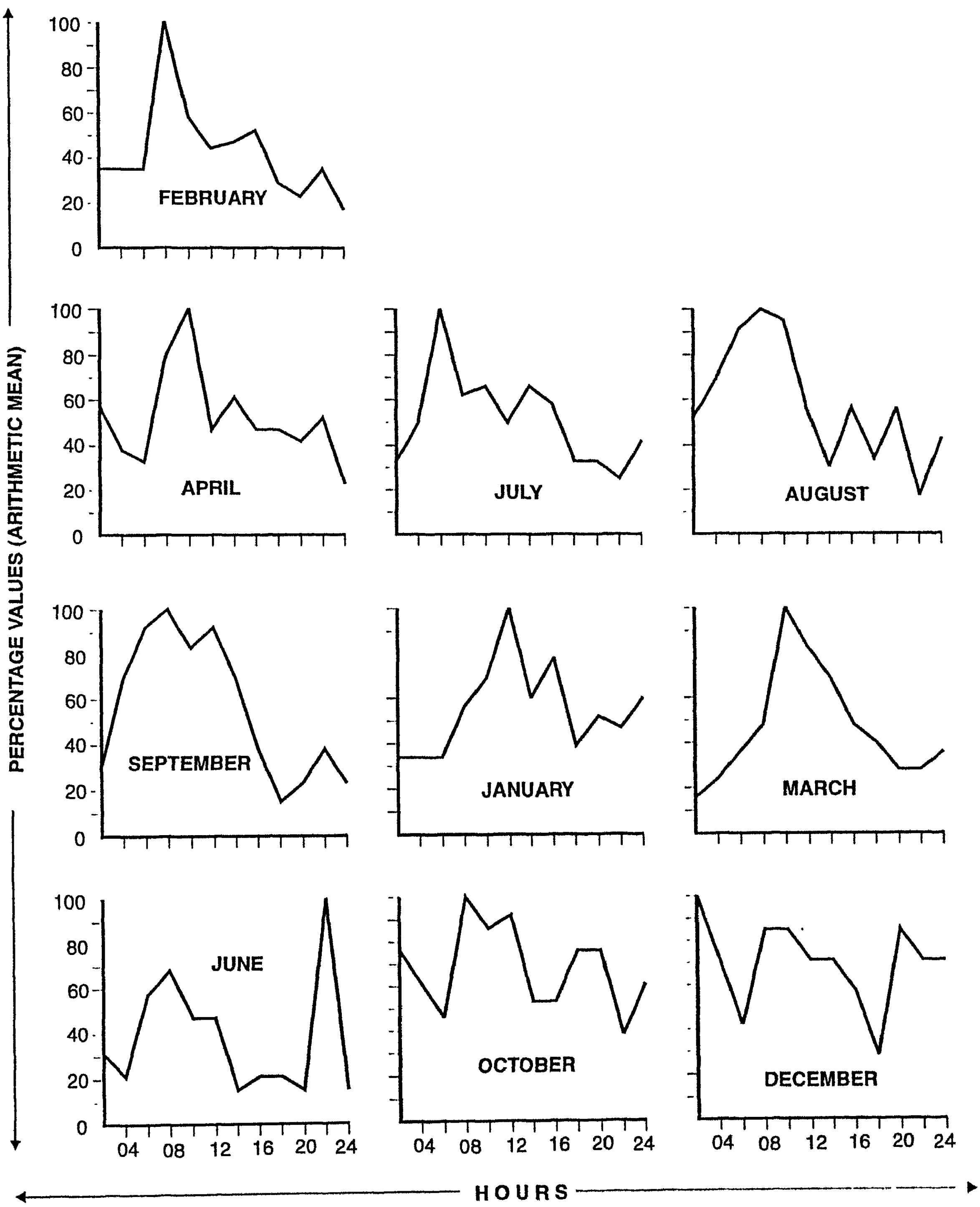
Pollen grains belonging to Amaranthaceae - Chenopodiaceae also showed one of their peaks during this period (Text figs. 4, 17, 18). Other herbaceous taxa showing moderate pollen catch were *Xanthium strumerium,*

Artemisia sp., Parthenium hysterophorus and those of Cyperaceae. A few tree taxa also contributed some amount of pollen to the atmosphere in this season viz. *Alnus* sp., *Acacia nilotica,* and *Cassia* spp.(Table 3).

Pollen grains represented in the air in very low frequencies were of *Aegle marmelos, Alternanthera sessilis, Brassica* sp. *Callistemon citrinus, Cannabis sativa, Celosia cristata, Coriandrum sativum, Croton bonplandianum, Eucalyptus* sp. *Gomphrena globosa, Impatiens balsamina, Morus alba, Peltophorum pterocarpum, Pinus roxburghii, Psidium guajava, Ricinus communis, Santalum album, Thuja /Cupressus, Tinospora cordifolia, Typha australis* and some belonging to families Acanthaceae, Arecaceae, Asteraceae, Malvaceae, Moraceae/Urticaceae and other Monocotyledons (Table 3, 4,& 5).

November to January (winter) is a moderate pollen frequency period recording 10%-23% of the total pollen catch (Text figs. 2,13,15). Dominant forms of this period were *Ricinus communis, Brassica* sp., *Callistemon citrinus, Caryota urens and Roystonea regia,* which were trapped in comparatively high frequencies, alongwith those belonging to Poaceae. Airborne pollen grains of *Parthenium hysterophorus, Coriandrum sativum,* Amaranthaceae - Chenopodiaceae and some members of Monocotyledons, showed occurrence in fair numbers while those present in sporadic numbers were of *Abutilon* sp.,*Acacia nilotica, Ailanthus excelsa, Alnus* sp., *Alternanthera sessilis, Bougainvillea sp., Cannabis sativa, Cassia* spp., *Casuarina equisetifolia, Celosia cristata, Coleus* sp., *Coronopus didynamus, Drypetes roxburghii, Ephedra foliata, Eucalyptus* sp., *Holoptelea integrifolia, Iberis amara, Impatiens balsamina, Justicia* sp., *Morus alba, Phoenix sylvestris, Pinus roxburghii, Plantago* sp. *Psidium guajava, Pterospermum acerifolium, Rorippa dubia, Rumex dentatus, Xanthium strumerium* and those belonging to Asteraceae, Cyperaceae, Malvaceae and Rutaceae (Tables, 3, 4, 5).

DIURNAL PERIODICITIES OF AERIAL CONCENTRATIONS OF AIRBORNE POACEAE POLLEN AT ALLAHABAD



Text-fig. 19

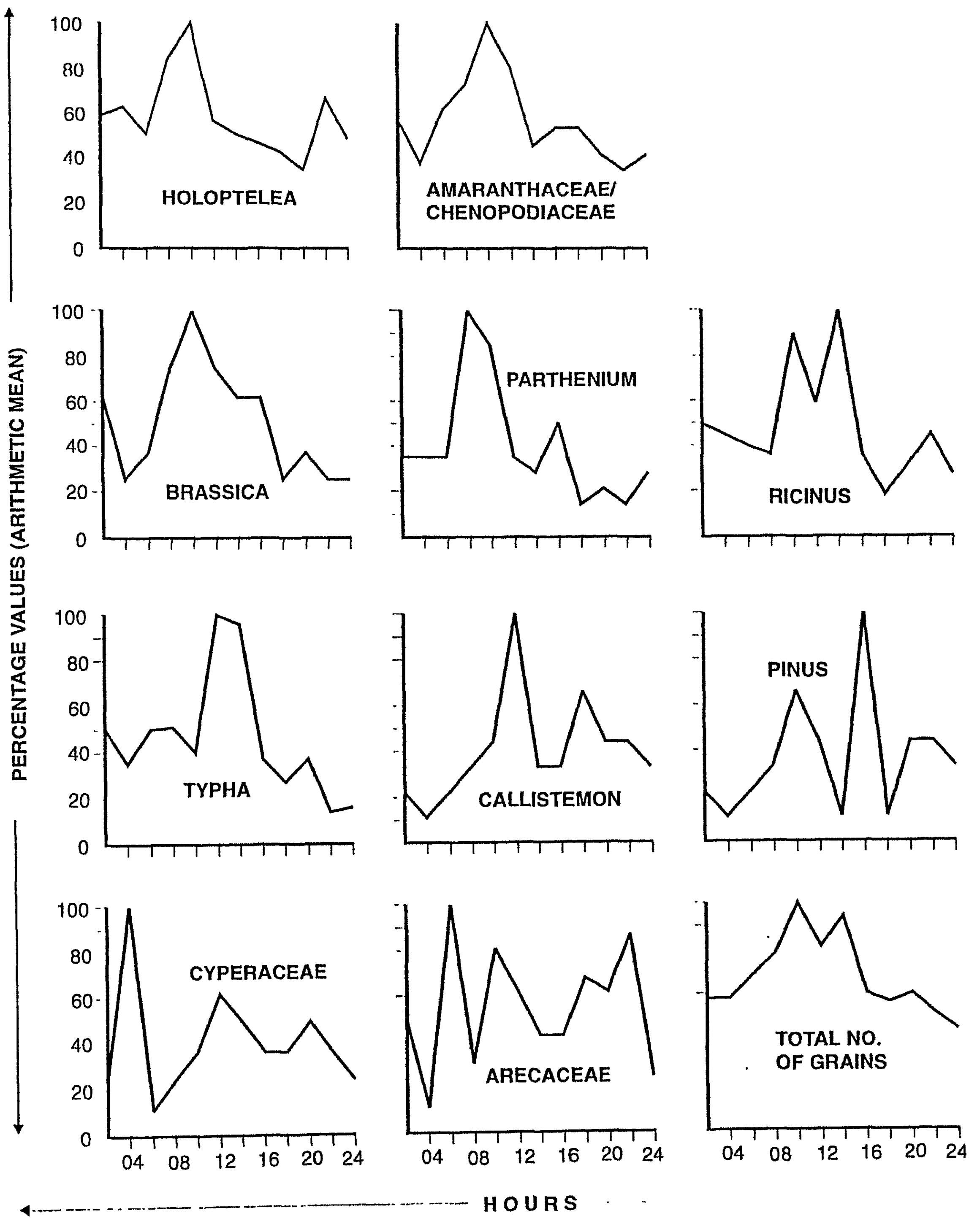
Diurnal periodicity

In general, the total pollen grains in the atmosphere of Allahabad showed a day pattern with maximum occurrence of grains between 6.00 to 14.00 hours, when more than 60% percent of the peak occurred(Text fig.20). The maximum peak occurred at 10.00 hrs followed by a minor peak at 14.00 hrs. Diurnal periodicity of 11 pollen morphotypes, which were recorded in high frequencies was studied. These are Poaceae, *Holoptelea*, *Pinus*, Amaranthaceae/Chenopodiaceae, *Porthenium*, *Brassica*, *Ricinus*, *Typha*, *Callistemon*, Cyperaceae and Arecaceae.

Poaceae is the most dominant, perpetually present allergenic pollen morphotype of the atmosphere of Allahabad, hence, its diurnal periodicity was recorded separately in each month (excluding May and November when, due to volumetric trap malfunction, catches were too low to give a definite diurnal pattern)

Pollen grains of Poaceae exhibited a forenoon pattern in the months of February, March, April and July, August, September. Peak concentrations of grass pollen in the air during August, September and February occurred at 8.00 hrs, in July at 6.00 hrs. and in March & April at 10.00 hrs. A day pattern was observed in January with a peak at 12.00 noon. Irregular patterns were seen in the months of June, October and December. In October the peak occurred at 8.00 hrs. followed by a minor peak at 12.00 noon. Peak concentrations in June and December were at 22.00 and 2.00 hrs respectively. (Text fig. 19) Among the other pollen types recorded, the diurnal periodicities of *Holoptelea*, Amaranthaceae/Chenopodiaceae, *Brassica* and*Parthenium* showed forenoon patterns with their peaks at 10.00 hrs. *Holoptelea* showed a minor peak as well at 22.00 hrs. *Typha* and *Ricinus* exhibited day patterns with their maximum incidence in the air

DIURNAL PERIODICITIES OF AERIAL CONCENTRATIONS OF SOME COMMON AIRBORNE POLLEN TYPES AT ALLAHABAD



Text-fig. 20

between 8.00 to 16.00 hrs. In *Ricinus* two peaks occurred within four hours , major at 14.00 hrs and minor peak at 10.00 hrs. In *Typha*, highest concentrations were visible between 12.00-14.00 hrs and its peak occurred at 12.00 hrs. Pollen of *Pinus* and *Callistemon* showed irregular patterns. *Pinus* showed a major peak at 16.00 hrs with another small peak at 10.00 hrs. while *Callistemon* showed maximum concentrations in the air at 12.00 noon followed by a small peak at 18.00 hrs. Similarly, no definite pattern was observed either in Cyperaceae or Arecaceae pollen. Their maxima occurred at 4.00 hrs and 6.00 hrs respectively (Text fig 20).

Airborne pollen incidence in relation to habit of the plants

The pollen grains trapped from the atmosphere could be divided into different categories as those belonging to grasses, herbs, shrubs and trees. During the 1990-91 survey, pollen belonging to arboreal species dominated the aeropalynoflora, contributing 20853 pollen (51%) followed by grass pollen 10336 (25%). Herbaceous pollen were caught in lower number viz. 5588 (14%) and the least common were those of shrubs (2613, 6%). While in the other surveys conducted during the present work 1991-92 and 1991, pollen grains of Poaceae dominated the aeropalynoflora. It constituted 35% (11270 m^{-3}) during the 1991 survey conducted by the Burkard spore trap, while in the Durham gravimetric survey from 1991-92, at sites A and B, its occurrence was 32.44% and 41.21% respectively. Percentage contribution of herbaceous and tree pollen was 27.1% and 23.7% during 1991 (BST) survey, while during 1991-92 at Site A and B , it was 26 % & 29.6% and contribution to the aeropalynoflora of shrub pollen was only 3.7% to 6.5% in different surveys (Test fig.24).

Altogether, it can be emphasized that the non-tree pollen dominated over the tree pollen in most of the surveys conducted at Allahabad,

except for the 1990-91 survey where tree pollen were comparatively higher in percentage (51%) to the non-tree (45%) pollen (Text figs. 25, 26, 27).

As regards the seasonal occurrence of tree and non tree pollen during different calendar months, the period from February to May was dominated by tree pollen and from October to November non-tree pollen dominated the aeropalynoflora. (Text figs. 25, 26, 27)

Aerial incidence of pollen grains in relation to the mode of pollination of plants.

The aerial incidence of pollen grains in relation to the mode of pollination in the present investigation revealed that the pollen grains of anemophilous plants were found in abundance, contributing 71-76% in various surveys. The most commonly represented anemophilous pollen grains were those of Poaceae, Cyperaceae,Amaranthaceae - Chenopodiaceae, *Pinus roxburghii, Ricinus communis, Caryota urens* and *Holoptelea integrifolia*. The anemophilous pollen grains were followed by those of amphiphilous plants; their percentage contribution to the total catch in various surveys was 7-18% represented by genera like *Azadirachta indica, Brassica , Drypetes roxburghii, Madhuca longifolia* and *Pongamia pinnata*. Although majority of the types represented in the aeropalynoflora belonged to entomophilous species, but their contribution was only 6.8-11% in various surveys.

During the survey of 1991 (BST) and the Durham gravity survey of 1991-92 (Site B),entomophilous pollen was 8.3 and 11.3 respectively. It was found that this increase was due to the increased catch of *Parthenium hysterophorus* and other members of Asteraceae, at site B during 1991-92 and in the 1991 survey (BST). Besides the abundance of the above types, there was also an increase in the entomophilous pollen grains of *Psidium* and *Callistemon*. It may be mentioned here that out of 91 pollen morphotypes recorded from the

atmosphere,19 types were anemophilous, 26 were amphiphilous and 46 types were entomphilous (Table 2).

Pollen production studies

Pollen production studies of eight plant species were done to estimate the number of pollen grains produced per anther and per flower and to correlate with their aerial incidence. The plants selected were *Amaranthus viridis, Azadirachta indica, Brassica campestris, Callistemon citrinus, Chenopodium album, Drypetes roxburghii, Holoptelea integrifolia* and *Ricinus communis.* Among these, pollen production of *Holoptelea* and *Drypetes* were determined by two methods, drop method as well as haemocytometer method while of remaining plants by drop method only. Number of anthers produced per anther and per flower of these selected plants are given in Table 6.

Pollen production capacity was found to be highest in *Holoptelea* (12034/anther) and lowest in *Azadriachta* (390/anther). High pollen production per anther in *Holoptelea* and its anemophilous mode of pollination are responsible for it being the chief component of atmospheric pollen spectrum. However larger number of anthers per flower in *Azadirachta* are responsible for copious production of pollen albeit a comparatively low production per anther.

Likewise abundance of pollen grains belonging to Amaranthaceae/Chenopodiaceae complex can be correlated with the pollen produced per anther (4200/anther in *Amaranthus viridis* and 3495/anther in *Chenopodium album*) and anemophilous mode of pollination. *Ricinus communis* is well represented in the atmospheric pollen spectrum of Allahabad as it is a high pollen producing plant. Here, it can be mentioned that the pollen produced per anther lobe is very low (483/lobe) but the pollen output per flower becomes very high due to presence of numerous anther lobes per flower. Although *Brassica* and *Drypetes* are amphiphilous in nature, their abundance in the air also can be

TABLE : 6 POLLEN PRODUCTION IN SOME PLANTS

DROP METHOD -

Plant name	Number of anthers	Pollen grains per anther	Pollen grain per flower
Amaranthus viridis	3	4200	12600
Azadirachta indica	10	390	3900
Brassica campestris	6	2908	17448
Callistemon citrinus	49	2838	139062
Chenopodium album	6	3495	17448
Drypetes roxburghii	3	3124	9372
Holoptelea integrifolia	6	12034	72204
Ricinus communis	Several anthers	483 per anther lobe	-

HAEMOCYTOMETER METHOD -

Plant name	Average number of grains per square	number of pollen grains per ml.	number of pollen grains in 2.5 ml.	Number of pollen grains per anther
Holoptelea integrifolia	3142.12	31421200	78553000	785530
Drypetes roxburghii	1784.25	17842500	44606250	446062

attributed to their high production per flower. Inspite of being a high pollen producer (139062/flower) poor representation of pollen grains of *Callistemon citrinus* in the air may be due to its entomophilous nature.

Pollen production by the haemocytometer method was studied for *Holoptelea* and *Drypetes*. When compared with the readings of the drop method it was found that the results were very much underestimated by this method viz; it was 12034 per anther in *Holopletea* by the drop method and 785,530 by the haemocytometer method. The same conclusions can be drawn for *Drypetes* where 3124 grains per anther were recorded by the drop method and 446062 by the haemocytometer method (Table 6).

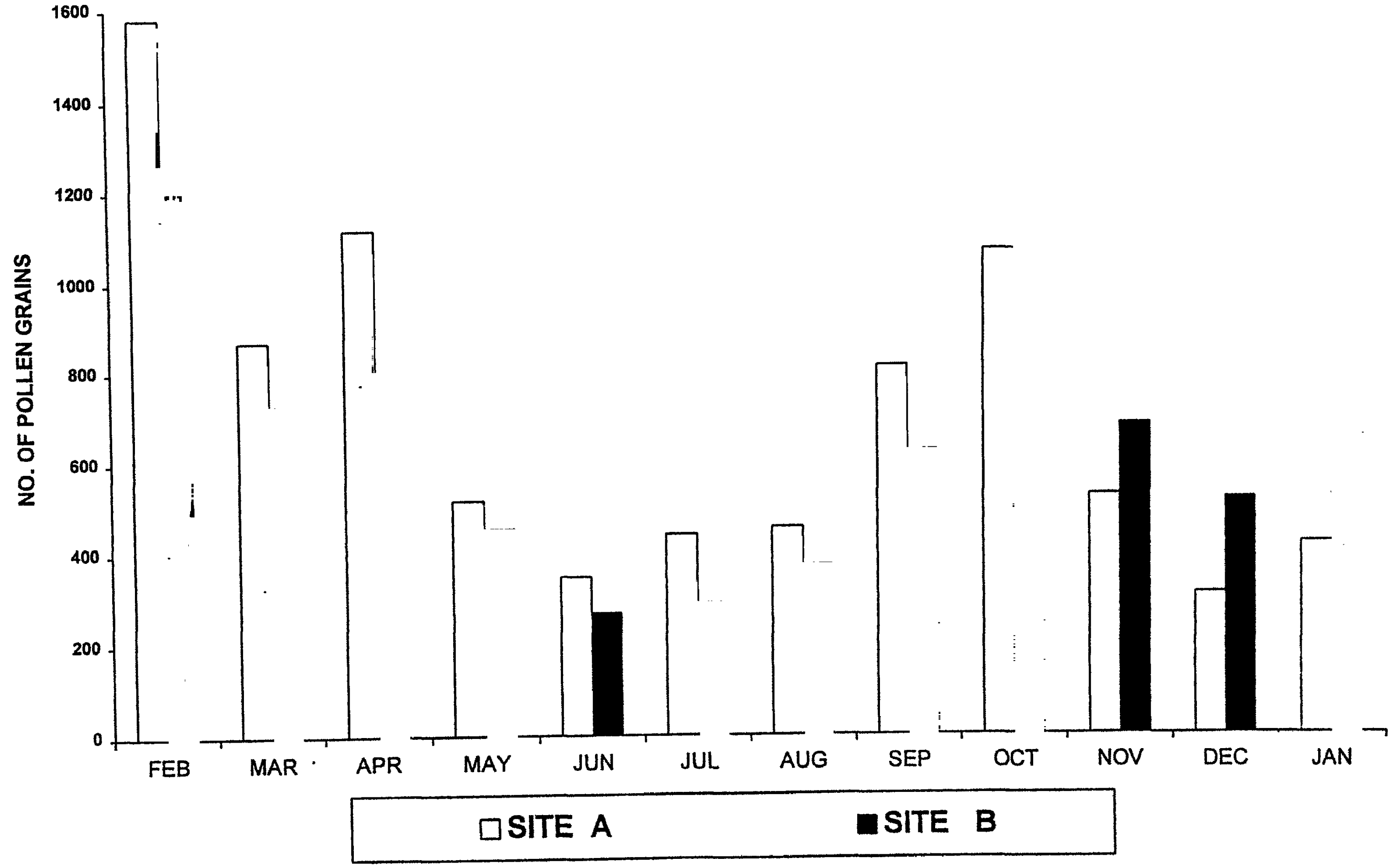
Hence, it can be concluded that pollen produced in plantsas well as their mode of pollination are directly correlated with their atmospheric pollen concentrations (Agashe & Soucenadin 1992). Besides these, other factors affecting airborne pollen frequencies are number of anthers per flower, number of inflorescence per plant and the distribution of source plants in and around the sampling site.

Comparative aeropalynological studies at Sites A & B

A comparative study of the two surveys conducted simultaneously at two sites A and B during February 1991 to Jnuary 1992 revealed qualitative as well as quantitaive differences in atmospheric pollen - spectrum.

The pollen calendars of Site A & Site B reflected their surrounding vegetation although the total pollen catches at the two sites were comparable (Site A - 8740, Site B - 7963) there were differences in their monthly catches and their annual peaks (Figs. 17, 18).In site A maximum pollen catch was observed in February while in site B it occurred in October. (Fig.21)

COMPARATIVE MONTHLY FREQUENCIES OF AIRBORNE POLLEN GRAINS AT TWO SITES (A & B) AT ALLAHABAD DURING 1991-1992



Text-fig. 21

Qualitatively 67 pollen morphotypes were recorded from site A, while at site B only 55 types were recorded (Table 5). Among them 49 pollen types were common to both the sites though in varying frequencies. 18 were present only at Site A and 6 exclusively at Site B. Pollen grains belonging to Poaceae, Amaranthaceae - Chenopodiaceae, Cyperaceae, *Parthenium hysterophorus* and those of other Monocotyledons occurred in the atmosphere almost throughout the year at both sites. Poaceae was the major contributor at both the sites showing 32.4% at site A and 41.2% at site B, followed by *Holoptelea integrifolia,* 14.7% and 10.8% and those belonging to other Monocotyledons contributing 5.7% and 8.6% respectively (fig.16). Pollen grains of Amaranthaceae - Chenopodiaceae and Cyperaceae were found in the atmosphere of both sites in almost similar concentrations. 5.1% of Amaranthaceae - Chenopodiaceae pollen was represented in the air of site A and 5.3% at site B while those of Cyperaceae were 1.5% and 1.2% respectively. *Ricinus communis* contributed comparatively a lower percentage at site A (4.8%) than at Site B(6.6%). Similarly percentage contribution of *Parthenium hysterophorous* and *Brassica* sp. was more at Site B (5.2% and 2.7% respectively) than at Site A (3.0% and 1.9% respectively). Similarly members of Asteraceae (1.3%), were also found dominating at site B. This could be attributed to the abundant growth of the taxa around Site B. *Typha australis, Madhuca longifolia, Drypetes roxburghii* and *Pinus roxburghii* were recorded in far more numbers at site A than at site B. Pollen grains of *Madhuca longifolia* contributed 3.6% of the total atmospheric pollen at site A and 1.1% at site B while those of *Typha australis* contributed 4.8% and 2.7% respectively. Similarly *Drypetes* contributed 0.89% at site A and only 0.58% at site B while *Pinus* was much more dominant at site A recording 1.6% and onl y 0.38% at site B. Abundance of these taxa at site A was perhaps due to the nearness of the source plants to the experimental site.

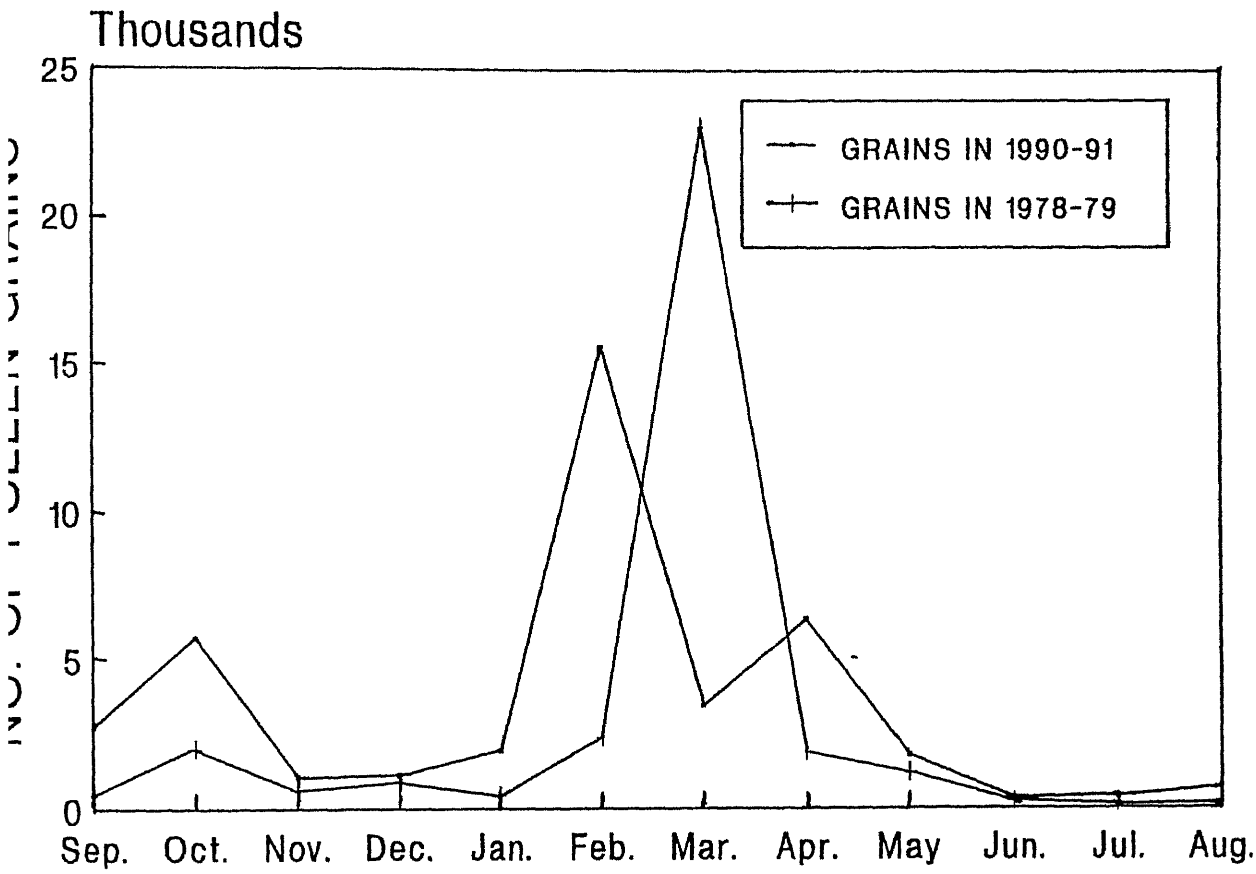
The other morphotypes represented from both the sites, though in lower frequencies were those of *Artemisia, Acacia nilotica, Aegle marmelos, Alnus sp., Azadirachta indica, Barringtonia acutangula, Bombax ceiba, Cannabis sativa, Cassia spp., Casuarina equisetifolia, Celosia cristata, Coriandrum sativum, Coronopus didynamus, Croton bonplandianum, Emblica officinalis, Morus alba, Polyalthia longifolia, Polygonum plebeium, Prosopis juliflora, Psidium guajava, Rorippa dubia, Rumex dentatus, Syzygium cumini, Terminalia arjuna, Toona ciliata , Xanthium strumerium* and those belonging to Acanthaceae, Apiaceae, Malvaceae, and Urticaceae/Moraceae (Table 5).

Among the pollen types recorded exclusively from site A, those of *Phoenix sylvestris* were recorded in moderate numbers, which may be due to the abundance of these trees in the botanical garden. Other types of exclusive occurrence at site A,though in lower frequencies were

Alternanthera sessilis, Cajanas cajan, Ephedra foliata, Gomphrena globosa, Milletia peguensis, Peltophorum pterocarpum, Phoenix sylvestris, Phlox drummondii, Plantago sp., Pongamia pinnata, Pterospermum acerifolium, Roystonea regia, Thuja/Cupressus, Tinospora cordifolia, and those belonging to other Apiaceae and Rutaceae. The pollen morphotypes represented only at site B were *Argemone mexicana, Delonix regia, Dianthus sp., Tamarindus indica* and those of Solanaceae.

The pollen calendars of sites A and B indicate that there is abundance of arboreal species around site A which contribute more pollen to the atmosphere, hence the yearly peak appeared in the tree flowering period viz. February, whereas paucity of arboreal species and abundance of grasses and herbs growing in wastelands, fields and roadsides at site B accounted for the dominance of herbaceous pollen in the atmosphere in the postmonsoon period,thereby the yearly peak occurred in October (Fig .21).

MONTHLY VARIATION OF TOTAL POLLEN GRAINS
IN THE ATMOSPHERE OF ALLAHABAD
DURING 1990-91 & 1978-79



Text-fig. 22a

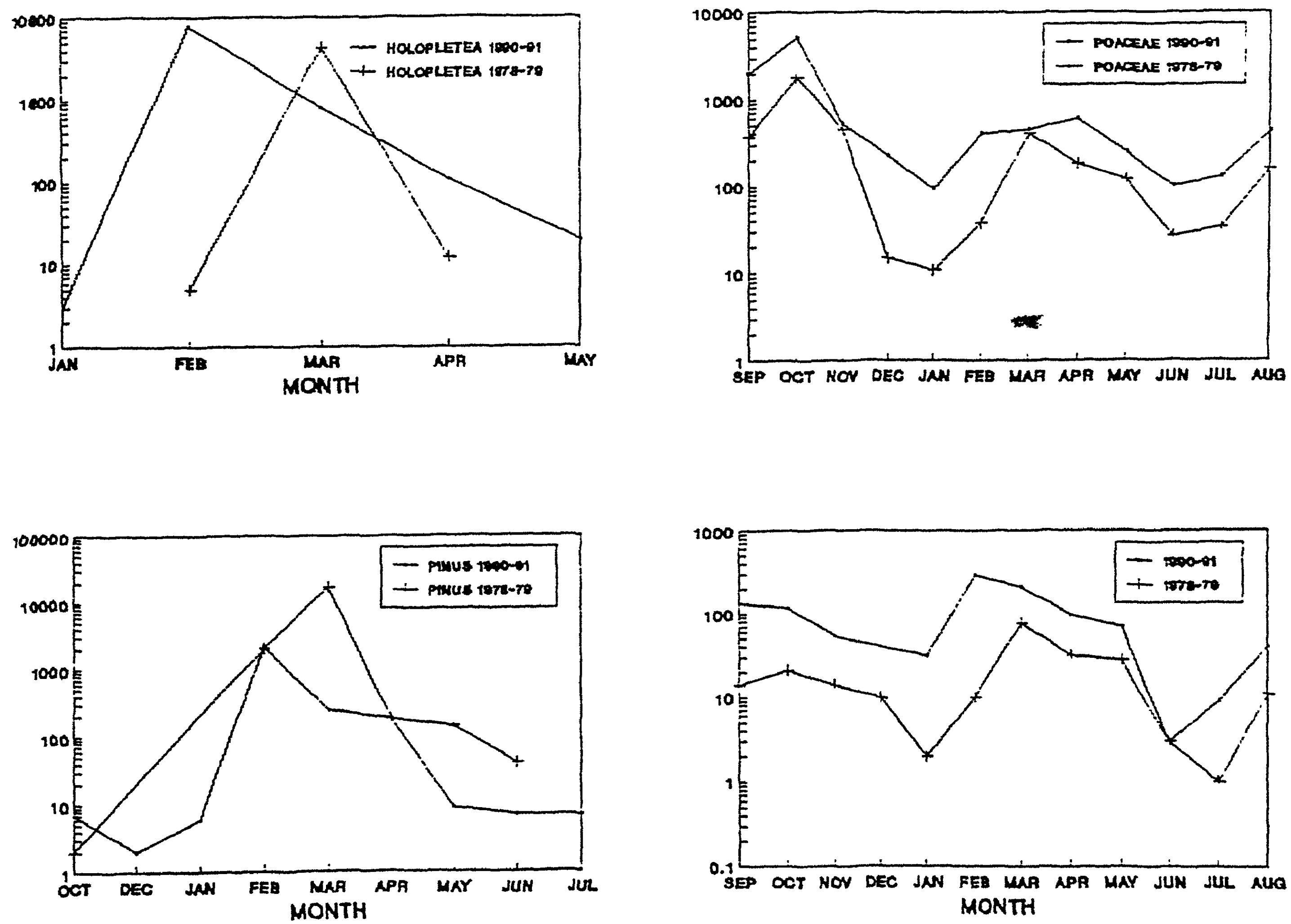
Comparative studies of 1990-91 survey with that conducted previously at Allahabad during 1978-79.

The results of the present survey of 1990-91 were compared with those of the previous survey conducted at Allahabad during 1978-79. Both the surveys were conducted at site A using the same aeroscope. However, in the 1990-91 survey the apparatus was shifted to the adjacent building of the same height. Analysis of the two aeropalynological surveys showed marked differences in the quantitative as well as the qualitative data.

Quantitatively in 1990-91 a total of 40862 pollen grains were caught while in the previous survey a total of 33198 pollen grains were recorded. Qualitatively 85 pollen types were identified in 1990-91 while during 1978-79, 50 types were recorded of which 48 pollen morphotypes were reported from both the surveys. Highest pollen frequency during 1978-79 was represented in the month of March when 23065 were recorded from the atmosphere and this peak had shifted to February in 1990-91 with a record of 15,554 grains (Fig.22). The low frequency period too had shown a shift,being in July with 104 grains during 1978-79 and in June during 1990-91 when only 330 grains were caught from the atmosphere.(Fig 22)

The aeropalynoflora in both the surveys were dominated by pollen of Poaceae, *Holoptelea integrifolia and Pinus roxburghii* (Fig.23). It is interesting to note that there is a three-fold increase in the Poaceae pollen over the years and the present survey represented a frequency of 10356 grains as against 3675 of the previous survey. *Holoptelea integrifolea* pollen too showed a two fold increase and a shift in the peak from March to February in the present survey. Pollen catch of *Holoptelea* in the 1978-79 survey was 4353 while in 1990-91 it was 8933. There is a remarkable decreacs in the aeropollen of *Pinus roxburghii*,

MONTHLY FREQUENCY OF AIRBORNE POLLEN DURING 1978-79 & 1990-91



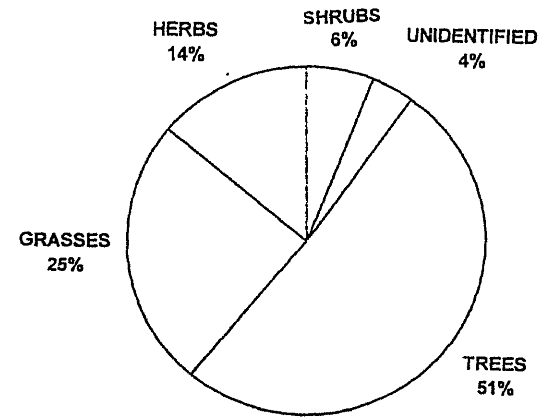
Text-fig. 23

with a record of 19511 in 1978-79 while only 2690 pollen grains were trapped in 1990-91 and the pollen peak too shifted from March in 1978-79 to February in 1990-91. Remarkable abundance of *Pinus* pollen during 1978-79 may be due to the close vicinity of the *Pinus* trees to the experimental building.

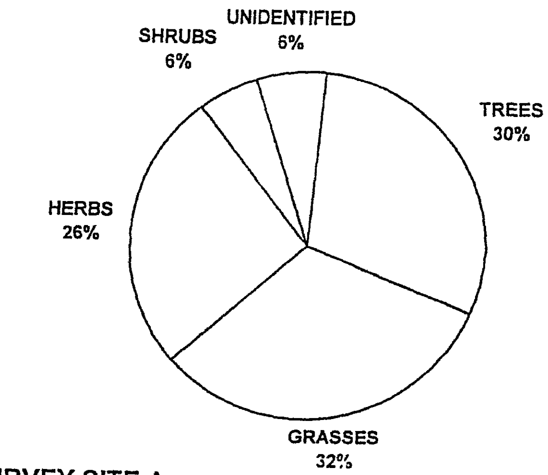
Other pollen types of significant occurrence in 1978-79 survey were of *Azadirachta, Cannabis, Casuarina*, Amaranthaceae-Chenopodiaceae, *Madhuca* and *Ricinus*, while in 1990-91, besides the above mentioned genera there was an addition of several other morphotypes among the dominating ones.These were *Drypetes (Putranjiva)* 1448 in 1990-91, 182 in 1978-79, *Caryota* 1002 in 1991-91, 142 in 1978-79, *Pongamia* 992 in 1990-91, while it was totally absent in 1978-79, this could be due to the close vicinity of the tree to the experimental site in the present survey. Here mention may be made of *Parthenium hysterophorus* which was represented by only 14 airborne grains in 1978-79 while in 1990-91 its incidence was of 842 grains, which was due to the drastic spreading of the obnoxious weed over the years on roadsides and wastelands.Similarly only 5 grains of *Brassica* were recovered from the air in the previous survey while 985 grains were recorded in the present study probably due to the presence of experimental plots during the study period. Among the pollen types which were recorded in significant numbers during 1978-79 and in low numbers in the present survey were those of *Milletia peguensis* and *Cannabis sativa*. This may be probably due to the eradication of these plants which were growing in 1978-79 in the botanical garden.

Certain additional species were identified from the atmosphere of Allahabad in the 1990-91 survey of which prominant in occurrence were *Barringtonia, Callistemon, Cassia, Coronopus, Eucalyptus, Justicia, Mangifera, Murraya, Phoenix, Prosopis, Roystonea, Syzygium, Tinospora,* and some members of Araceae, Monocotyledons and Urticaceae-Moraceae.

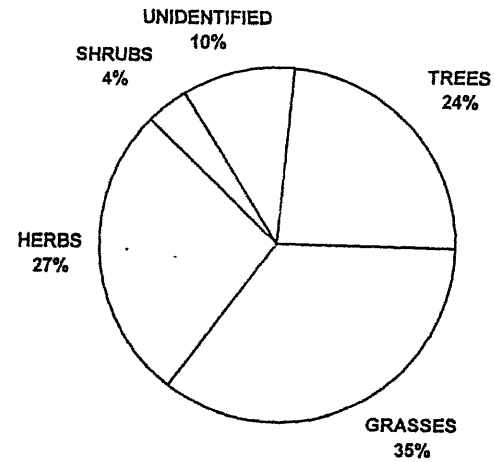
POLLEN SPECTRA SHOWING PERCENTAGE CONTRIBUTION OF HERB, SHRUB, GRASS AND TREE POLLEN IN THE ATMOSPHERE OF ALLAHABAD



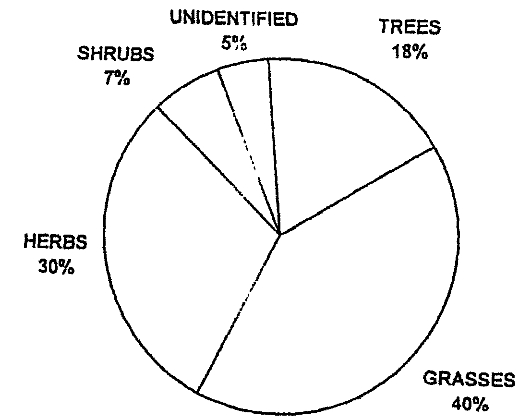
1990 - 91 SURVEY



1991- 92 SURVEY SITE A



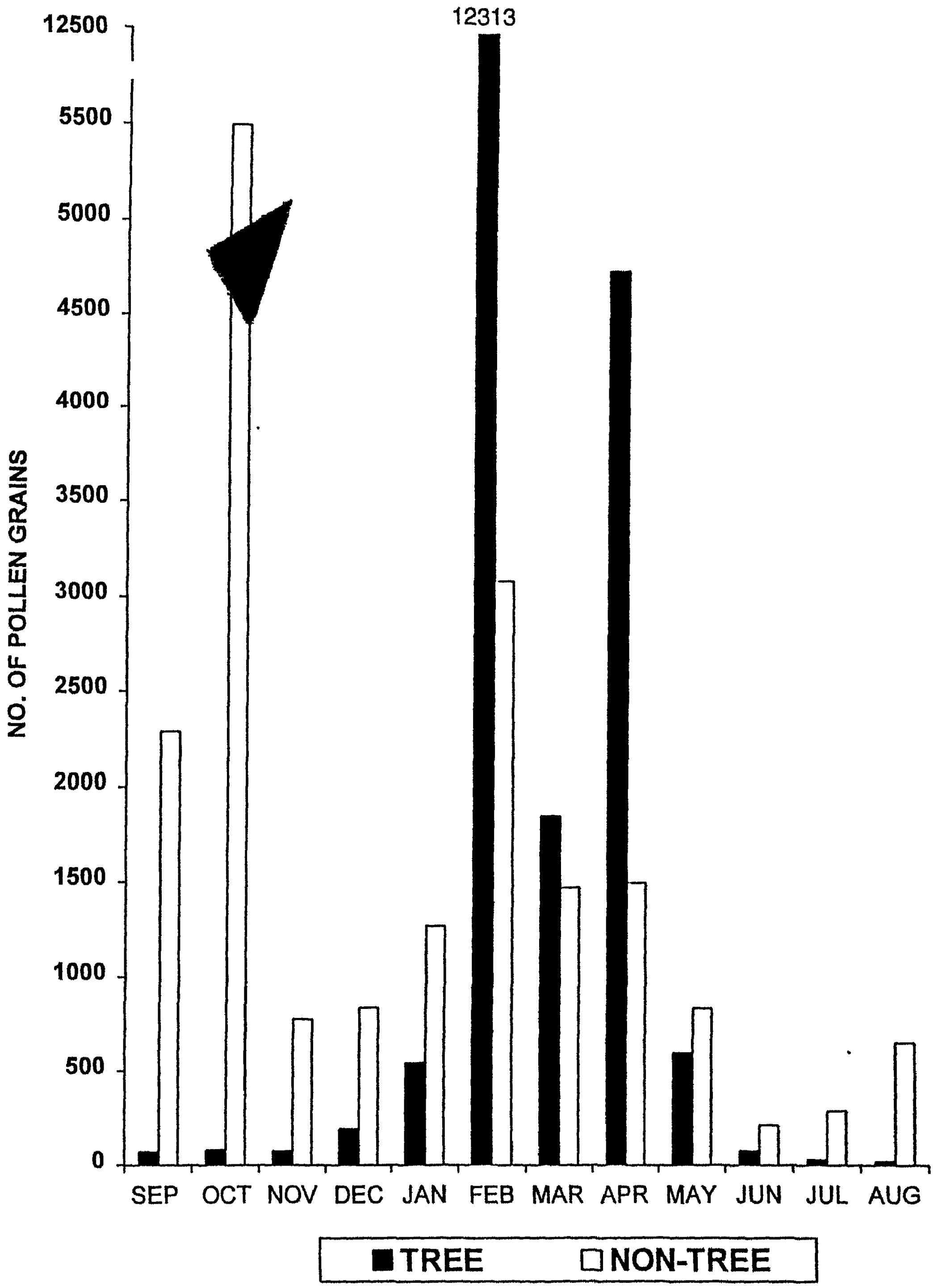
1991 SURVEY



1991 - 92 SURVEY SITE B

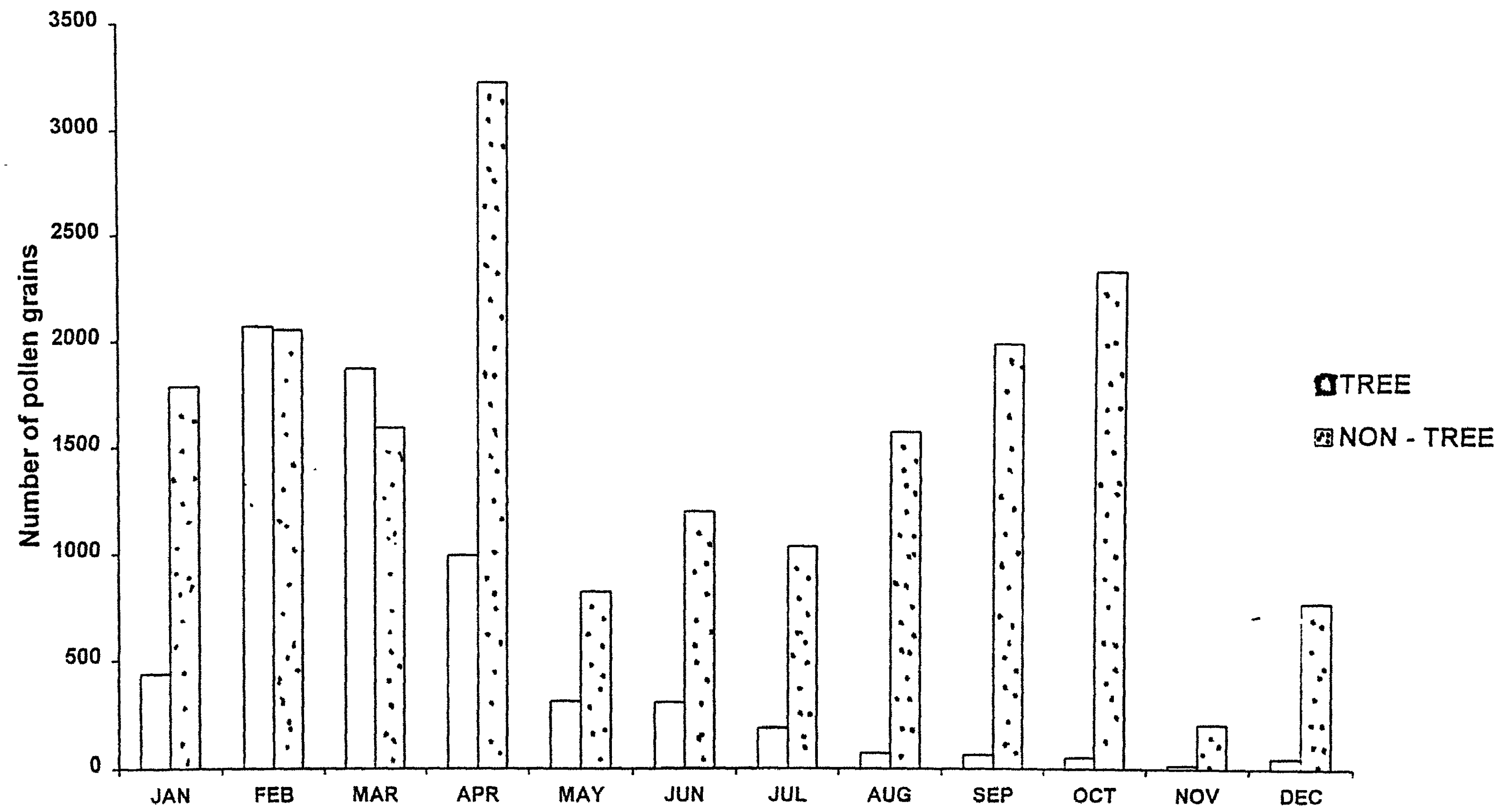
Text-fig. 24

COMPARATIVE MONTHLY FREQUENCIES OF TREE AND NON-TREE POLLEN GRAINS IN THE ATMOSPHERE OF ALLAHABAD DURING 1990-1991



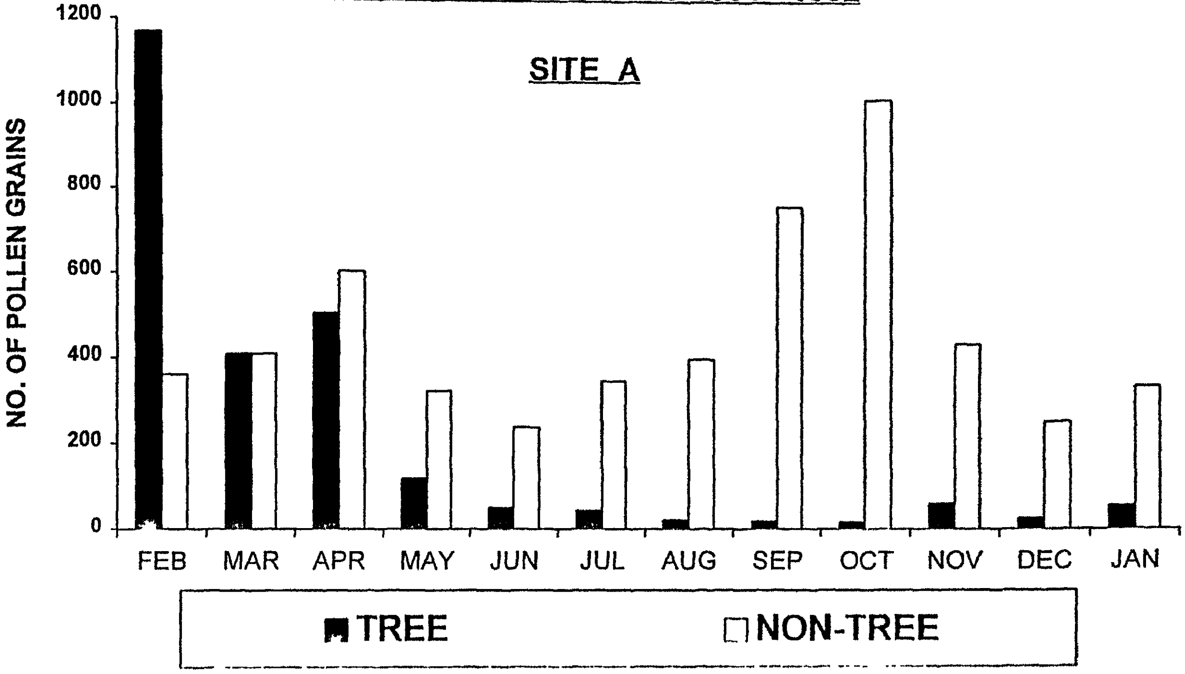
Text-fig. 25

COMPARATIVE MONTHLY FREQUENCIES OF TREE - NON-TREE POLLEN GRAINS IN THE ATMOSPHERE OF ALLAHABAD DURING 1991

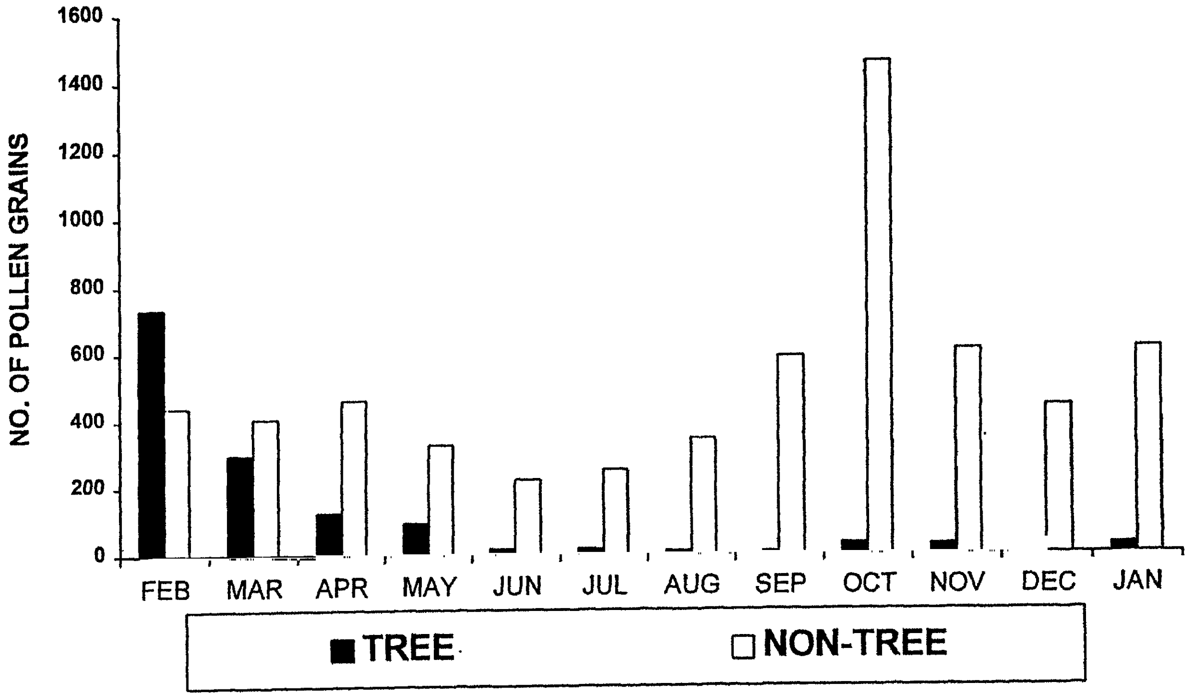


Text-fig. 26

COMPARATIVE MONTHLY FREQUENCIES OF TREE AND NON-TREE POLLEN GRAINS IN THE ATMOSPHERE OF ALLAHABAD DURING 1991 - 1992



SITE - B



Text-fig. 27

Comparison of two surveys with different pollen-trapping devices

In the present study of atmospheric bioelements two kinds of gravity samplers were used viz a Lakhanpal & Nair sampler (1958) and a Durham gravity sampler (1946) to estimate the efficiency of the apparatuses. Available data of simultaneous surveys conducted at site A during 1991, using above mentioned samplers were compared (Table 7)

During the period of seven months a total of 28510 grains were caught by the Lakhanpal aeroscope while only 5318 grains were trapped by the Durham sampler. Qualitatively slides exposed on the Lakhanpal & Nair sampler showed appearance of 76 pollen morphotypes while those of Durham sampler recorded 63 pollen morphotypes. Of these, 57 types were common in both the surveys. Although these morphotypes showed relatively no changes in the trends of their seasonal variations, they were present in much varying frequencies (Table 7).

The majority of the pollen morphotypes recorded, showed their presence in much higher frequencies in the Lakhanpal survey than the Durham survey. For example, 2356 Poaceae pollen and 8930 *Holoptelea* pollen were caught in the Lakhanpal survey while 905 and 1238 were caught in the Durham survey respectively. *Pinus* was recovered in very high numbers in the Lakhanpal survey (2675) as compared to the Durham survey (129). Similar was the case with *Drypetes* (Lakhanpal : 1445, Durham : 81) and Caryota (Lakhanpal : 732, Durham : 64).However, pollen grains of *Alnus, Casuarina, Thuja-Cupressus* were recorded in slightly higher numbers in the Durham survey. Besides common pollen morphotypes recovered in both the surveys there were a few types which were present exclusively in either of the surveys, albeit in stray numbers. Of these

TABLE :7 MONTHLY CATCH OF AIRBORNE POLLEN RECORDED BY TWO DIFFERENT POLLEN SAMPLERS FROM FEBRUARY TO AUGUST 1991

PLANT NAME	APP.	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTAL
1. ACACIA NILOTICA	LNS	-	-	-	-	1	6	17	24
	DGS	-	-	-	-	-	1	4	5
2. AEGLE MARMELOS	LNS	-	-	-	65	28	1	-	94
	DGS	-	-	5	7	-	-	-	12
3. AILANTHUS EXCELSA	LNS	373	21	1	3	1	-	-	399
	DGS	29	12	3	1	-	-	-	45
4. ALNUS SP.	LNS	-	-	-	-	1	2	-	3
	DGS	10	-	-	2	-	-	-	12
5. AMARANTHACEAE/ CHENOPODIACEAE	LNS	296	210	98	69	3	9	41	726
	DGS	24	73	22	24	11	20	27	201
6. OTHER APIACEAE	LNS	3	16	3	-	-	-	-	22
	DGS	2	-	-	1	-	-	-	3
7. ARGEMONE MEXICANA	LNS	-	4	4	-	-	-	-	8
	DGS	-	-	-	-	-	-	-	-
8. OTHER ASTERACEAE	LNS	12	26	4	21	2	1	-	66
	DGS	4	-	5	4	4	13	3	33
9. AZADIRACHTA INDICA	LNS	-	7	750	109	2	-	-	868
	DGS	-	-	43	6	5	1	-	55
10.BARRINGTONIA ACUTANGULA	LNS	-	3	5	17	2	5	5	34
	DGS	-	-	-	-	1	-	7	8
11. BOMBAX CEIBA	LNS	8	1	-	3	-	-	-	12
	DGS	4	-	-	-	-	-	-	4
12. BRASSICA SP.	LNS	511	16	20	6	-	-	-	553
	DGS	41	12	3	2	1	4	-	63
13. CALLISTEMON CITRINUS	LNS	17	42	53	5	2	1	1	121
	DGS	13	6	10	5	-	2	-	36
14. CANNABIS SATIVA	LNS	3	14	21	19	1	2	-	60
	DGS	-	9	3	9	2	-	2	25
15. CARYOTA URENS	LNS	562	1	146	-	23	-	-	732
	DGS	12	-	-	1	23	26	2	64
16. CASSIA SP.	LNS	2	1	-	5	-	2	1	11
	DGS	1	-	5	2	-	-	2	10

PLANT NAME	APP.	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTAL
17. CASUARINA EQUISETIFOLIA	LNS	-	7	-	-	-	-		7
	DGS	10	-	2	-	-	-	-	12
18. CELOSIA CRISTATA	LNS	-	4	4	-	-	-	-	8
	DGS	-	2	-	-	-	-	-	2
19. CORIANDRUM SATIVUM	LNS	33	28	4	2	-	-	-	67
	DGS	3	10	1	1	-	-	-	15
20. CORONOPUS DIDYNAMUS	LNS	22	-	-	-	-	-	-	22
	DGS	-	-	-	-	-	-	-	-
21. CROTON BONPLANDIANUM	LNS	2	3	6	4	-	4	2	21
	DGS	-	-	-	-	-	-	1	1
22. CYPERACEAE	LNS	2	5	-	14	14	16	59	110
	DGS	3	1	2	2	7	3	40	58
23. DELONIX REGIA	LNS	-	2	6	37	-	-	-	45
	DGS	-	-	-	-	-	-	-	-
24. DRYPETES ROXBURGHII	LNS	790	302	341	12	*-	-	-	1445
	DGS	11	31	32	1	6	-	-	81
25. EMBLICA OFFICINALIS	LNS	-	40	41	3	-	-	-	84
	DGS	-	5	9	-	1	2	-	17
26. EPHEDRA FOLIATA	LNS	28	17	42	-	5	6	-	98
	DGS	1	1	2	-	-	-	-	4
27. EUCALYPTUS SP.	LNS	89	17	4	-	-	-	-	110
	DGS	6	3	1	-	-	-	-	10
28. FERONIA LIMONIA	LNS	-	-	8	-	-	-	-	8
	DGS	-	3	-	-	2	-	-	5
29. GNAPHALIUM SP.	LNS	14	1	-	-	-	-	-	15
	DGS	-	1	-	-	-	-	-	1
30. HOL OPTELEA INTEGRIFOLIA	LNS	7994	808	108	20	-	-	-	8930
	DGS	942	252	31	13	2	3	-	1238
31. IBERIS AMARA	LNS	149	5	-	-	-	-	-	154
	DGS	2	-	5	-	-	-	-	7
32. MADHUCA LONGIFOLIA	LNS	-	153	1451	85	-	-	-	1689
	DGS	-	30	250	18	3	1	-	302
33. OTHER MALVACEAE	LNS	3	1	1	-	2	-	-	7
	DGS	-	-	2	-	7	-	-	9

PLANT NAME	APP.	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTAL
34. MILLETIA PEGUENSIS	LNS	13	4	9	3	-	-	-	29
	DGS	-	-	1	-	-	-	-	1
35. OTHER MONOCOTYLEDONS	LNS	146	305	126	48	19	43	58	745
	DGS	35	30	111	56	21	69	31	353
36. MORUS ALBA	LNS	129	23	44	15	8	3	-	222
	DGS	1	-	3	8	3	1	-	16
37. PARTHENIUM HYSTEROPHORUS	LNS	200	88	94	170	48	36	26	662
	DGS	-	10	90	26	12	31	13	182
38. PELTOPHORUM PTEROCARPUM	LNS	-	-	-	-	-	-	-	-
	DGS	-	-	1	-	-	4	-	5
39. PHOENIX SYLVESTRIS	LNS	84	92	15	4	-	-	-	195
	DGS	36	31	2	8	-	-	-	77
40. PINUS ROXBURGHII	LNS	2217	252	183	9	7	7	-	2675
	DGS	90	23	10	1	5	-	-	129
41. POACEAE	LNS	401	450	601	248	101	129	426	2356
	DGS	69	140	135	73	56	177	255	905
42. POLYALTHIA LONGIFOLIA	LNS	-	1	622	29	-	-	-	652
	DGS	-	-	36	5	-	-	-	41
43. POLYGONUM PLEBEIUM	LNS	1	1	17	35	-	-	-	54
	DGS	-	-	-	15	1	-	-	16
44. PONGAMIA PINNATA	LNS	-	14	898	80	-	-	-	992
	DGS	-	-	45	11	-	-	-	66
45. PROSOPIS JULIFLORA	LNS	1	2	45	5	-	-	-	53
	DGS	1	4	7	3	-	-	-	15
46. PSIDIUM GUAJAVA	LNS	-	-	-	-	-	-	-	-
	DGS	-	-	-	-	-	1	5	6
47. PTEROSPERMUM ACERIFOLIUM	LNS	-	21	2	-	-	-	-	23
	DGS	-	1	-	-	-	-	-	1
48. RICINIS COMMUNIS	LNS	1037	99	10	-	-	-	-	1146
	DGS	156	62	8	-	-	-	-	226
49. ROYSTONEA REGIA	LNS	31	-	-	-	-	-	-	31
	DGS	-	-	2	-	-	-	-	2

PLANT NAME	APP.	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTAL
50. RUMEX DENTATUS	LNS	16	12	1	2	-	-	-	31
	DGS	6	8	-	-	-	-	-	14
51. SAMANEA SAMAN	LNS	1	5	10	-	-	-	-	16
	DGS	-	-	1	-	-	-	-	1
52. SPATHODEA SP.	LNS	-	-	6	1	-	-	-	7
	DGS	-	1	-	1	-	-	-	2
53. SYZYGIUM CUMINI	LNS	-	-	1	95	-	-	-	96
	DGS	2	3	28	1	2	1	-	37
54. TERMINALIA ARJUNA	LNS	-	7	9	2	-	-	-	18
	DGS	2	-	-	-	-	-	-	2
55. THUJA / CUPRESSUS	LNS	3	-	4	-	-	1	-	7
	DGS	1	41	3	-	-	1	2	48
56. TINOSPORA CORDIFOLIA	LNS	9	6	4	1	1	2	26	49
	DGS	-	-	-	-	-	3	11	14
57. TOONA CILIATA	LNS	166	8	-	-	-	-	-	174
	DGS	-	4	1	-	-	-	-	5
58. TYPHA AUSTRALIS	LNS	-	162	368	150	8	41	15	744
	DGS	-	3	147	101	116	23	11	401
59. URTICACEAE / MORACEAE	LNS	2	1	-	10	10	-	2	25
	DGS	-	2	2	-	-	-	2	6
60. XANTHIUM STRUMERIUM	LNS	-	-	3	28	-	-	2	33
	DGS	-	-	-	9	1	-	-	10
UNIDENTIFIED	LNS	145	70	73	328	39	39	61	755
	DGS	52	51	69	73	59	51	37	392
TOTAL GRAINS	LNS	15552	3415	6332	1769	328	360	739	28495
	DGS	1567	862	1113	517	350	439	452	5300

LNS = Lakhanpal & Nair Sampler **DGS = Durham gravity sampler**

15 were reported in the Lakhanpal survey and 2 exclusively in the Durham survey (Table 7).

The above analysis of the two simultaneous surveys of the two samplers reveals that though qualitatively there were few variances between the two, quantitatively there was a five fold increase in the catch of the Lakhanpal sampler over the Durham, which may be because of the movement of the exposed slide in relation to the direction of wind, (the sticky surface of the slide always faces the direction of wind).

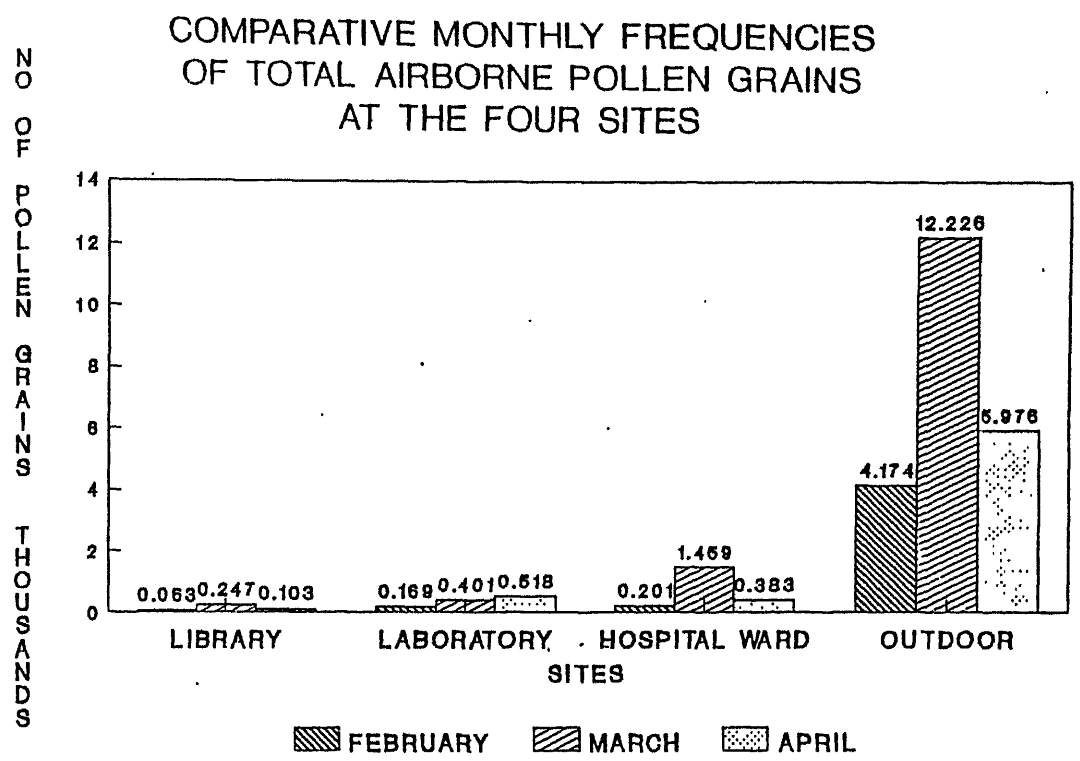
Indoor Aeropalynological Surveys

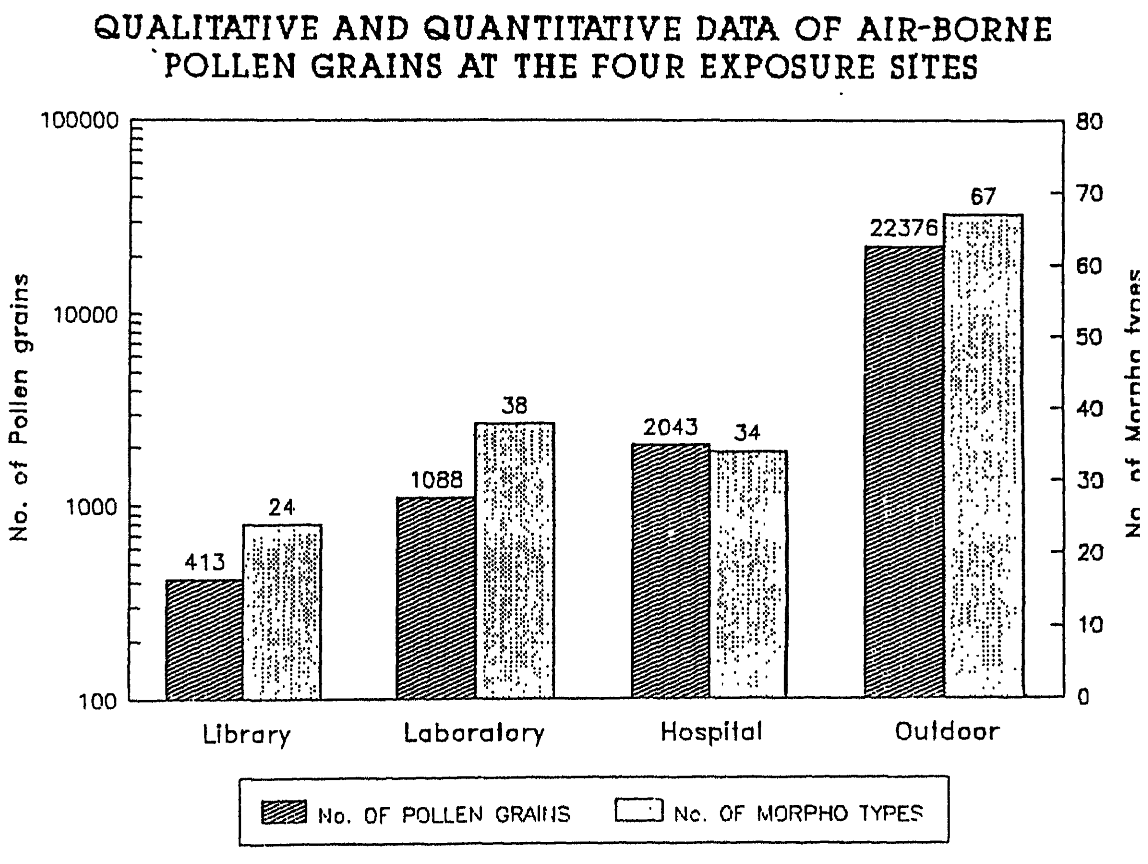
Survey of 3 selected indoor environments viz., library, science laboratory and hospital ward were made from February 1992 to April 1992. To compare the indoor aeropalynofloras with that of the outdoor, a simultaneous outdoor survey at Site A, for the same period was also conducted.

Library : During the period of 3 months a total 413 pollen grains were captured from the indoor environment of library. The highest pollen load was noted in the month of March with a record of 247 pollen grains followed by the next highest pollen catch of 103 in the month of April. The month of Februaryshowed the minimum pollen catch of 63 pollen grains (Table 8).

Qualitatively 24 morphotypes were identified. (Fig 28) Pollen grains of *Holoptelea integrifolia*, *Pinus roxburghii* and those belonging to Poaceae, Chenopodiaceae - Amaranthaceae complex were found in dominance. Other common types were pollen grains of Araceae, Arecaceae and *Brassica* sp. Dominant and the common types constituted 87.38 of the total pollen catch.

Science Laboratory : A total of 1088 pollen were trapped from the indoor environment of the laboratory during the 3 month survey. The maximum pollen frequency was recorded in the month of April with a catch of 518 pollen grains. The


COMPARATIVE MONTHLY FREQUENCIES OF TOTAL AIRBORNE POLLEN GRAINS AT THE FOUR SITES
NO OF POLLEN GRAINS THOUSANDS
14
12
10
8
6
4
2
0
0.063
0.247
0.103
0.169
0.401
0.518
0.201
1.469
0.383
4.174
12.226
5.976
LIBRARY
LABORATORY
HOSPITAL WARD
OUTDOOR
SITES
FEBRUARY
MARCH
APRIL


QUALITATIVE AND QUANTITATIVE DATA OF AIR-BORNE POLLEN GRAINS AT THE FOUR EXPOSURE SITES
100000
10000
1000
100
No. of Pollen grains
80
70
60
50
40
30
20
10
0
413
24
1088
38
2043
34
22376
67
Library
Laboratory
Hospital
Outdoor
No. OF POLLEN GRAINS
No. OF MORPHO TYPES

Text-fig. 28

next highest frequency was in March with a record of 401 pollen grains. The minimum number was encountered in February with a catch of 169 pollen grains.

Qualitatively 36 morphotypes were i dentified (Fig. 28). Among the different species, the pollen grains of *Holoptelea integrifolia*, *Pinus roxburghii* and those belonging to Poaceae, Chenopodiaceae-Amaranthaceae were predominant. Other types included pollen grains of *Ricinus communis*, Arecaceae, *Phoenix*, *Caryota urens*, *Madhuca longifolia*, *Pongamia* and *Azadirachta indica* (Table 8).

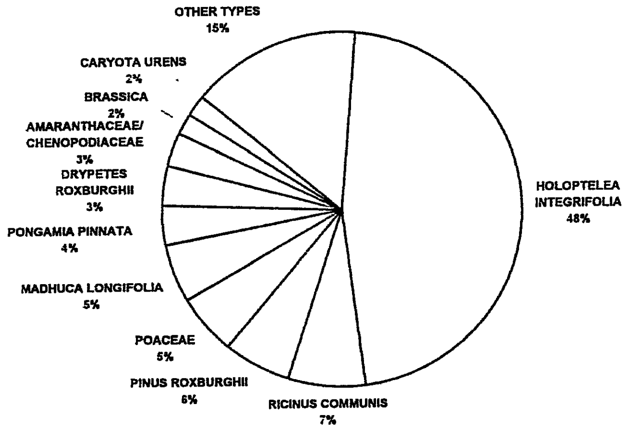
Hospital Ward : A total of 2043 pollen grains were caught from the indoor atmosphere of the hospital ward during the period of 3 months. The maximum catch was in the month of March with a total of 1459. Next highest catch was in April with 183 pollen grains. Minimum catch of 201 pollen grains was found in the month of February.

Qualitatively 34 morphotypes were identified (Fig.28). The pollen grains of *Holoptelea integrifolia*, Poaceae, *Ailanthus excelsa*, Chenopodiaceae - Amaranthaceae and *Ricinus communis* were predominant. Other common types were those of Araceae, *Zea mays*, *Azadirachta indica*, *Brassica*, *Parthenium hysterophorus*, *Pinus roxburghii*, Arecaceae, *Bombax ceiba*, *Emblica officinalis*, *Madhuca longifolia*, *Drypetes roxburghii* and *Typha australis*. These morphotypes constituted 39.68% of the total catch from the atmosphere (Table 8).

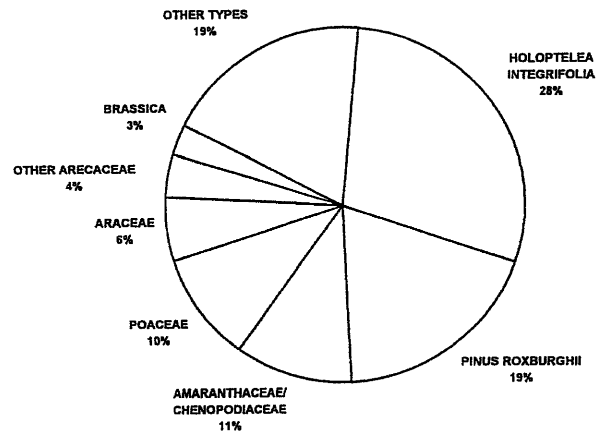
Outdoor Site : In the outdoor survey a total of 22376 pollen grains was recorded. Maximum catch was in the month of March with a total of 12226 pollen grains. This was followed with a total catch of 5976 in the month of April and the minimum pollen catch of 4174 was recorded in the month of February.

Qualitatively 66 morphotypes were identified (Fig.28). The dominant morphotypes were those of *Holoptelea integrifolia, Ricinus communis*, *Pinus roxburghii*, Poaceae and *Madhuca longifolia*. Other common types recorded

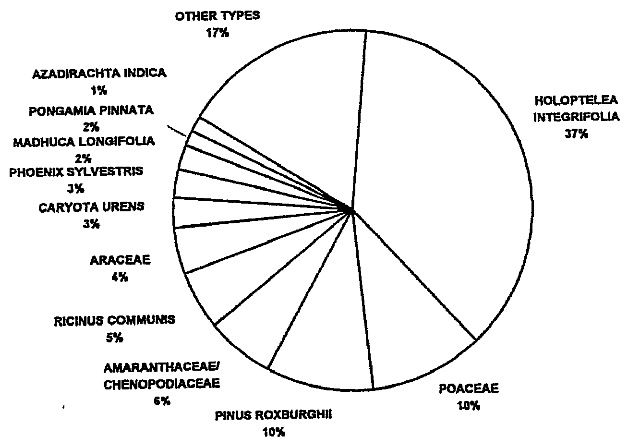
POLLEN SPECTRA OF THE FOUR EXPOSURE SITES FEB 1 - APR 30 1992



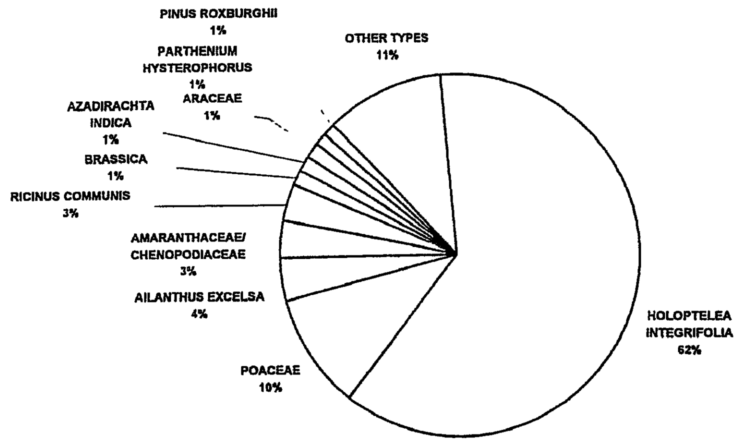
OUTDOOR



LIBRARY

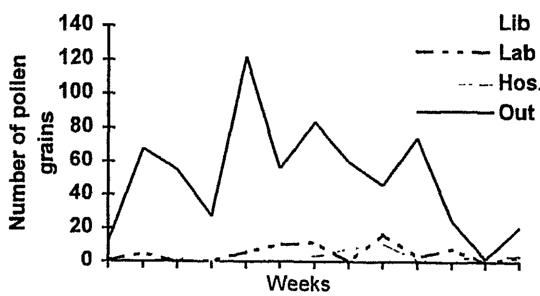


LABORATORY

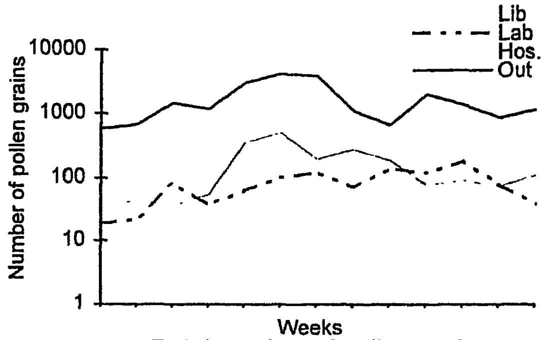


HOSPITAL

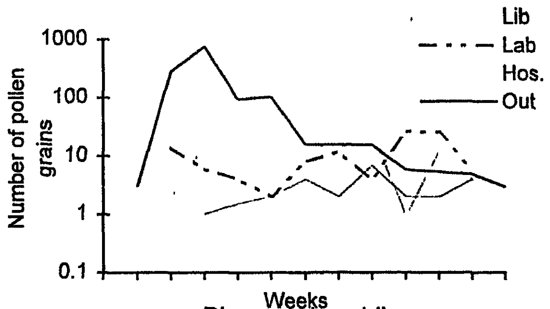
WEEKLY INCIDENCE OF AIRBORNE POLLEN GRAINS AT THE FOUR EXPOSURE SITES FROM IST FEB. TO 30TH APR. 1992



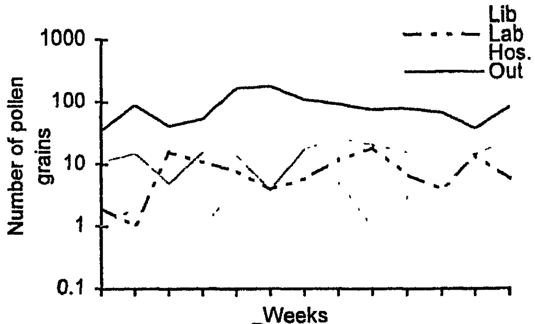
Amaranthaceae / Chenopodiaceae



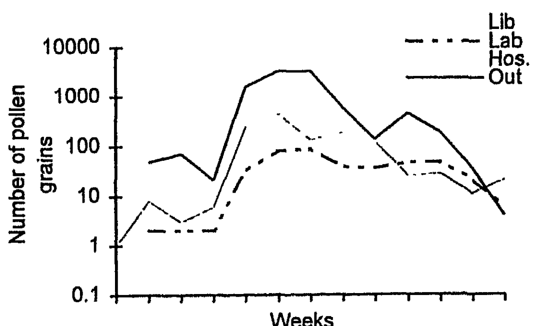
Total number of pollen grains



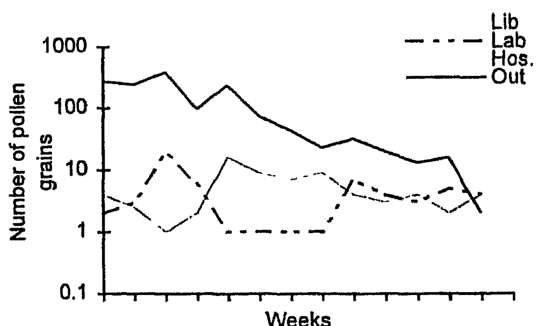
Pinus roxburghii



Poaceae



Holoptelea integrifolia



Ricinus communis

Text-fig. 30

were *Azadirachta indica*, *Pongamia pinnata*, Chenopodiaceae - Amaranthaceae, *Drypetes roxburghii*, *Zea mays*, *Brassica* sp., *Caryota urens*, *Toona ciliata*, *Ailanthus excelsa*, *Typha australis*, *Polyalthia longifolia*, *Parthenium hysterophorus*, Arecaceae and *Casuarina equisetifolia*. These pollen morphotypes constituted 94.13% of the total catch from the atmosphere (Table 8).

Study of Indoor environment

The data collected from the present work reveal that the indoor environment is contaminated with diverse bioelements of plant and animal origin. In the present study we have taken into account the infiltration of pollen grains only.

Among the three indoor environments hospital ward showed the highest concentration of pollen grains while the lowest was recorded in the library (Fig. 28, Table 9).

The month of March recorded the highest pollen catch at all the sites except the laboratory where the highest catch was recorded in mid-April (Fig. 28). In the library the peak was observed in the last week of March while in hospital and outdoor environments the peak was observed in mid-March (Fig. 30).

Qualitatively the maximum number of morphotypes were recorded in the outdoor environments (66 types). Among indoor environments the laboratory site recorded relatively a higher number of morphotypes (36 types) followed by hospital ward (34 types). The library site recorded the minimum number (24 types).

All the four selected environments which include an outdoor and three indoor environments showed presence of pollen grains of *Holoptelea integrifolia*, *Ricinus communis*, *Pinus roxburghii*, Poaceae, *Madhuca longifolia*, *Azadirachta indica*, *Pongamia pinnata*, *Drypetes roxburghii*, Chenopodiaceae - Amaranthaceae, *Brassica* sp, *Parthenium hysterophorus*, Araceae, Arecaceae, *Plantago*

Table 8 WEEKLY TOTALS OF AIRBORNE POLLEN GRAINS AT THE FOUR EXPOSURE SITES FROM 1st. FEB. TO 30TH APR. 1992.

Plant name	Sites	Weeks													Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	
1. HOLOPTELEA INTEGRIFOLIA (A)	Lib	-	-	-	-	17	28	8	8	28	8	5	11	6	119
	Lab	-	2	-	2	32	80	88	38	36	46	47	21	6	398
	Hos	1	8	3	6	239	433	133	184	122	25	28	11	21	1214
	Out	-	48	72	21	1587	3286	3338	581	138	457	192	35	4	9759
2. RICINUS COMMUNIS (A)	Lib	-	-	-	-	-	-	-	-	2	-	-	1	1	4
	Lab	2	3	19	6	1	1	1	1	7	4	3	5	4	57
	Hos	4	-	1	2	16	9	7	9	4	3	4	2	4	65
	Out	278	243	387	97	236	73	44	23	32	20	13	16	2	1464
3. PINUS ROXBURGHII (A)	Lib	3	-	2	15	12	3	-	-	27	1	11	4	-	78
	Lab	-	-	14	6	-	2	8	12	4	27	26	6	-	105
	Hos	-	-	-	1	-	2	4	2	7	2	2	4	-	24
	Out	-	3	286	768	94	104	16	-	16	6	-	5	3	1301
4. POACEAE (A)	Lib	1	2	3	1	4	6	2	5	1	3	7	3	3	41
	Lab	2	1	16	11	8	4	6	12	19	7	4	14	6	110
	Hos	11	15	5	16	14	4	18	27	21	16	14	15	25	201
	Out	35	90	42	54	171	184	113	96	77	81	70	39	86	1138
5. CHENOPODIACEAE / AMARANTHACEAE (A)	Lib	-	8	2	-	2	12	4	2	4	2	1	5	3	45
	Lab	1	5	-	-	6	10	12	-	17	3	8	-	3	65
	Hos	-	2	-	11	12	9	3	8	11	1	3	2	4	66
	Out	12	68	55	27	122	56	84	60	46	75	25	2	21	653
6. BRASSICA SP. (A)	Lib	2	1	1	2	-	2	2	1	-	-	-	-	-	11
	Lab	-	4	-	2	-	1	-	-	1	-	2	-	-	10
	Hos	2	1	-	-	12	2	3	6	-	-	-	1	1	28
	Out	70	89	59	20	140	27	4	17	-	2	6	3	-	437
7. OTHER ARECACEAE	Lib	-	1	2	1	1	1	6	2	2	-	-	-	-	16
	Lab	1	1	12	1	2	-	1	2	11	5	4	6	-	46
	Hos	-	4	6	3	2	2	1	-	-	-	-	-	4	22
	Out	-	-	33	-	-	7	3	2	49	91	35	19	4	243

...CONTD

Plant name	Sites	Weeks													Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	
8. ARACEAE	Lib	-	-	1	3	-	3	-	4	11	-	-	3	-	25
	Lab	2	1	1	2	-	-	-	-	-	-	-	2	2	10
	Hos	4	8	13	5	2	1	2	7	3	-	2	1	-	48
	Out	-	-	-	-	-	-	-	-	-	18	-	-	-	18
9. MADHUCA LONGIFOLIA	Lib	-	-	-	-	-	-	-	-	-	-	-	-	1	1
	Lab	-	-	-	-	-	-	-	-	3	8	11	1	-	23
	Hos	-	-	-	-	-	-	-	-	-	4	5	4	3	16
	Out	-	-	-	2	6	13	12	15	86	588	277	19	112	1130
10. AZADIRACHTA INDICA (A)	Lib	-	-	-	-	-	-	-	1	-	-	-	-	1	2
	Lab	-	-	-	-	-	-	-	-	-	2	10	-	3	15
	Hos	-	-	-	-	-	-	-	-	4	4	6	9	5	28
	Out	-	-	3	-	1	3	-	-	14	233	327	60	261	902
11. PONGAMIA PINNATA	Lib	-	-	-	-	2	-	-	-	-	-	-	-	-	2
	Lab	-	-	-	-	-	-	-	-	3	3	5	6	-	17
	Hos	-	-	-	-	-	2	-	5	-	-	-	-	-	7
	Out	-	-	-	-	-	-	5	10	7	-	69	531	134	756
12. DRYPETES ROXBURGHII (A)	Lib	-	-	-	-	-	-	-	-	2	-	-	-	-	2
	Lab	-	-	-	-	-	-	-	2	-	-	3	1	-	6
	Hos	3	-	-	-	1	-	1	1	4	1	2	1	1	15
	Out	36	6	177	46	79	34	24	11	47	192	24	5	40	721
13. ZEA MAYS	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	3	3	7	1	5	-	2	3	2	7	33
	Out	-	25	28	11	76	68	32	21	13	34	50	39	128	525
14. CARYOTA URENS	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	2	3	3	-	1	-	-	-	6	8	5	2	-	30
	Hos	1	-	-	-	1	-	-	-	-	-	-	-	-	2
	Out	94	29	35	4	45	2	3	-	31	36	81	-	3	363

...CONTD

Plant name	Sites	Weeks													
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	Total
15.	Lib	-	-	-	-	-	-	-	-	-	-	3	-	1	4
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOONA CILIATA	Hos	-	-	-	-	1	-	-	-	-	-	-	-	1	2
	Out	1	-	-	2	26	174	144	16	-	-	-	-	-	363
16.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AILANTHUS	Lab	-	-	-	3	3	-	-	1	-	-	-	-	-	7
EXCELSA (A)	Hos	1	1	9	5	29	10	11	3	-	2	-	3	2	76
	Out	10	6	20	33	180	40	3	3	-	5	-	-	-	300
17.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TYPHA	Lab	-	-	-	-	-	-	-	-	-	-	-	-	1	1
AUSTRALIS (A)	Hos	6	-	-	-	-	-	-	-	2	-	1	3	2	14
	Out	-	-	-	-	-	-	-	-	-	-	40	14	207	261
18.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
POLYALTHIA	Lab	-	-	-	-	-	-	-	-	-	-	2	6	-	8
LONGIFOLIA (A)	Hos	-	-	-	-	-	-	-	-	-	-	1	1	3	5
	Out	-	-	-	-	-	-	-	-	-	-	102	55	99	256
19.	Lib	-	-	-	-	-	-	-	-	1	-	-	-	1	2
PARTHENIUM	Lab	-	-	-	-	3	-	-	-	-	-	-	-	-	3
HYSTEROPHORUS	Hos	-	-	-	1	3	1	2	3	5	2	4	-	5	26
(A)	Out	-	-	69	2	-	5	-	88	18	25	-	6	39	252
20.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CASUARINA	Lab	-	-	-	1	1	1	2	-	2	-	-	1	-	8
EQUISETIFOLIA	Hos	-	-	-	-	1	1	2	-	-	-	-	-	-	4
	Out	8	17	35	48	81	21	6	2	-	-	-	-	-	218
21.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IBERIS AMARA(A)	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	24	13	100	11	30	10	-	-	-	-	2	5	-	195

...CONTD

Plant name	Sites	Weeks													Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	
22. ROYSTONEA REGIA	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	19	33	25	15	66	3	-	-	-	-	161
23. PROSOPIS JULIFLORA (A)	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	1	2	-	-	1	1	-	5
	Out	-	-	-	-	19	18	-	12	10	15	10	3	3	90
24. EMBLICA OFFICINALIS	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	9	-	-	-	-	9
	Hos	-	-	-	-	2	-	-	-	-	1	5	3	5	16
	Out	-	2	-	-	20	51	-	-	4	-	-	-	-	77
25. RUMEX DENTATUS (A)	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	4	-	-	19	24	5	6	4	-	-	-	62
26. PLANTAGO SP	Lib	-	-	-	-	1	1	4	-	-	-	-	-	-	6
	Lab	-	-	3	-	-	2	-	-	-	-	-	2	-	7
	Hos	-	-	-	-	-	-	-	1	-	-	-	-	-	1
	Out	-	2	-	-	37	10	-	-	4	2	-	-	-	55
27. PHOENIX SYLVESTRIS (A)	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	28	-	-	28
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	-	-	4	34	13	-	-	51
28. OTHER MONOCOTYLEDONS	Lib	-	-	-	-	5	1	-	-	-	1	-	-	-	7
	Lab	-	-	-	-	-	-	-	-	2	-	2	-	-	4
	Hos	-	-	-	-	-	1	-	4	-	-	-	-	1	6
	Out	3	9	16	-	10	-	-	-	-	-	-	-	-	38

...CONTD

Plant name	Sites	Weeks													Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	
29.	Lib	-	-	-	-	-	-	-	1	1	-	-	-	-	2
OTHER	Lab	-	-	-	-	-	1	1	-	2	-	6	-	-	10
ASTERACEAE	Hos	-	-	-	-	1	-	-	-	1	1	-	-	-	3
	Out	-	2	-	-	10	16	-	12	1	-	-	-	-	41
30.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CANNABIS	Lab	-	-	-	-	-	-	-	-	-	-	2	-	-	2
SATIVA (A)	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	-	18	8	7	-	-	4	37
31.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FERONIA	Lab	-	-	-	-	-	-	-	-	3	-	-	-	-	3
LIMONIA (A)	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	-	-	-	20	13	-	3	36
32.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EUCALYPTUS SP	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(A)	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	6	2	1	1	15	-	-	4	-	-	2	-	-	31
33.	Lib	-	-	-	-	-	-	-	1	-	-	-	-	-	1
EPHEDRA	Lab	-	-	-	-	-	-	-	1	-	-	-	-	-	1
FOLIATA	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	3	-	-	3	3	2	9	4	4	-	-	-	28
34.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CALLISTEMON	Lab	-	-	1	-	1	-	-	-	2	-	-	-	2	6
CITRINUS (A)	Hos	-	-	-	-	-	-	-	-	-	-	1	-	1	2
	Out	-	3	-	3	7	-	7	-	7	-	-	-	-	27
35.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	1	1
MANGIFERA	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
INDICA	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	19	-	4	-	-	-	-	23

...CONTD

Plant name	Sites	Weeks													Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	
36 MORACEAE / URTICACEAE (A)	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	1	1
	Out	-	-	1	1	10	-	3	6	-	-	-	-	-	21
37 GNAPHALIUM SP.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	1	1
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	-	3	-	3	8	4	-	18
38. BOMBAX CEIBA(A)	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	1	2	-	1	4	3	5	2	1	3	22
	Out	-	-	-	-	3	3	3	5	3	-	-	-	-	17
39. TINOSPORA CORDIFOLIA	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	1	-	3	1	-	6	4	2	-	-	-	-	-	17
40. CORIANDRUM SATIVUM (A)	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	6	4	-	-	2	-	-	-	-	12
41. SYZYGIUM CUMINI (A)	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	2	-	-	-	-	2
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	-	-	-	-	10	-	-	10
42. OTHER ACANTHACEAE	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	1	1	-	2	-	2	-	-	-	-	-	2	8

...CONTD

Plant name	Sites	Weeks													Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	
43.	Lib	-	-	-	-	-	-	-	-	-	1	-	-	-	1
THUJA /	Lab	-	-	3	-	-	-	-	-	2	-	-	1	1	7
CUPRESSUS	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	7	5	1	3	1	-	-	-	-	-	-	17
44.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CORONOPUS	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DIDYNAMUS	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	1	1	5	-	-	-	-	-	-	-	-	7
45.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CYPERACEAE (A)	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	1	-	1	-	-	-	-	-	-	2
	Out	-	2	-	-	-	-	2	1	2	-	-	-	-	7
46.	Lib	-	-	-	-	-	1	-	-	1	-	-	-	1	3
PTEROSPERMUM	Lab	-	1	1	-	-	-	-	-	1	-	-	-	-	3
ACERIFOLIUM	Hos	-	1	-	-	-	-	-	-	-	-	-	-	-	1
	Out	-	-	1	-	2	-	-	1	-	3	-	-	-	7
47.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CAJANAS CAJAN	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	1	-	-	-	1	-	-	-	-	-	-	-	2
	Out	-	1	-	-	3	-	-	2	-	-	-	-	-	6
48.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
XANTHIUM	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STRUMERIUM (A)	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	3	2	-	-	-	-	-	-	-	-	-	5
49.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CROTON	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BONPLANDIANUM	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(A)	Out	-	-	-	-	-	-	-	-	-	-	2	2	-	4

...CONTD

Plant name	Sites	Weeks													Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	
50.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MALVACEAE	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	1	-	-	-	-	-	-	-	-	1	-	-	2
	Out	-	-	-	-	1	-	-	3	-	-	-	-	-	4
51.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TERMINALIA	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ARJUNA (A)	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	2	-	-	-	-	-	2	-	-	-	-	4
52.	Lib	-	-	-	-	-	-	-	1	-	-	-	-	-	1
JUSTICIA SP.	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	2	-	-	-	-	-	-	-	1	-	-	-	3
53.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MILLETIA	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PEGUENSIS	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	-	-	3	-	-	-	-	3
54.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RORIPPA DUBIA	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	1	2	-	-	-	-	-	-	-	-	-	-	-	3
55.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER APIACEAE	Lab	-	-	-	-	-	-	-	-	-	-	-	-	1	1
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	-	-	-	-	2	-	-	2
56.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BARRINGTONIA	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ACUTANGULA	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	-	-	-	-	-	-	2	2

...CONTD

Plant name	Sites	Weeks													Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	
57.	Lib	-	-	-	-	-	1	-	1	-	-	-	-	-	2
PHLOX	Lab	-	-	-	-	-	-	1	-	-	-	-	-	-	1
DRUMMONDII	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	2	-	-	-	-	-	-	-	2
58.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PITHECELOBIUM	Lab	-	-	-	-	-	-	-	-	-	-	1	-	-	1
DULCE (A)	Hos	-	-	-	-	-	-	-	-	-	-	2	2	-	4
	Out	-	-	-	-	-	-	-	-	-	1	- -	-	1	2
59.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SAMANEA	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SAMAN	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	-	-	2	-	-	-	-	2
60.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SOLANACEAE	Lab	1	-	-	-	-	-	-	-	-	-	2	-	-	3
	Hos	-	2	-	-	-	-	-	-	-	-	-	-	2	4
	Out	-	-	1	1	-	-	-	-	-	-	-	-	-	2
61.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPATHODIA SP.	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	1	-	1	-	-	-	-	-	-	2
62.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AEGLE	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MARMELOS	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63.	Lib	-	-	-	-	-	1	-	-	-	-	-	-	-	1
ALTERNANTHERA	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SESSILIS (A)	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	1	-	-	-	-	-	-	-	-	-	-	-	1

...CONTD

Plant name	Sites	Weeks													Total
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	
64. CONVOLVULUS SP.	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Out	-	-	-	-	-	-	-	-	-	1	-	-	-	1
65. POLYGONUM PLEBEIUM	Lib	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Hos	-	-	-	-	-	-	-	-	-	-	-	-	5	5
	Out	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UNIDENTIFIED	Lib	1	2	1	3	3	3	3	7	5	1	2	2	3	36
	Lab	2	2	10	4	6	-	4	3	10	7	14	6	7	75
	Hos	1	1	-	1	12	15	6	7	2	8	5	8	5	71
	Out	5	11	21	6	22	13	18	15	11	13	21	6	12	174
TOTAL	Lib	7	14	12	25	47	63	25	38	85	17	29	29	22	413
	Lab	19	20	83	38	64	102	124	72	142	120	185	80	39	1088
	Hos	34	45	37	55	354	500	197	278	189	77	92	74	111	2043
	Out	584	680	1462	1185	3066	4229	3932	1109	670	2022	1394	868	1175	22376

(A) : Reported to be allergenic.

sp, *Pterospermum acerifolium* and some members of monocotyledons. Among these, pollen grains of *Holoptelea integrifolia, Pinus roxburghii,* Poaceae and Chenopodiaceae - Amaranthaceae were found in dominant numbers in all the environments. Although pollen of *Ricinus communis* showed a clear dominance in the outdoor and two indoor environments viz. laboratory and hospital, but was present in lesser numbers in the library iste. In all the indoor environments pollen grains of Araceae were found in stray numbers throughout the period of investigation whereas in outdoor environment they were recorded only in the 1st week of April. Pollen grains of *Brassica* sp. and *Parthenium hysterophorus* were present in significant numbers only in two environments i. e. outdoor and hospital while indoor environments of library and laboratory showed their stray occurrence. Pollen grains of *Pongamia pinnata, Drypetes roxburghii, Plantago* sp. and some belonging to monocots and Asteraceae were present in stray numbers in all the indoor environments, while their presence in the outdoor atmosphere was quite significant. All the sites showed stray occurrence of pollen grains of *Pterospermum acerifolium.*

There is a second category of those pollen grains which were only at two indoor environments i.e. laboratory and hospital apart from their presence at the outdoor site. These include pollen grains of *Caryota urens, Ailanthus excelsa, Typha australis, Polyalthia longifolia, Casuarina equisetifolia, Emblica officinalis, Callistemon citrinus, Pithecelobium dulce* and Solanaceae, Pollen grains of *Toona ciliata* were found in the indoor environments of library and hospital sites whereas the pollen grains of *Ephedra foliata, Thuja/Cupressus* and *Phlox drummondii* were found in the library and laboratory sites.

There exists yet a third category of those pollen grains which were present only in one indoor environment apart from their presence in outdoor environment. These include pollen of *Phoenix sylvestris, Cannabis sativa, Feronia limonia, Gnaphalium* sp. and Apiaceae, (present in the laboratory site), *Mangifera indica, Justicia* sp. and *Alternanthera sessilis* (present in the library), *Prosopis*

juliflora, Moraceae/Utricaceae, *Bombax* ceiba, Cyperaceae, *Cajanus cajan, Zea mays* and members of Malvaceae (present in the hospital site).

Pollen grains of *Iberis amara, Roystonea regia, Rumex dentatus and Eucalyptus* sp., which were recorded in significant numbers from outdoor environment showed their complete absence in all the indoor environments. Other types of aero-pollen recorded from outdoor environment were those of *Tinospora cordifolia, Coriandrum sativum,* Acanthaceae, *Coronopus didynamus, Xanthium strumerium, Croton bonplandianum, Terminalia arjuna, Milletia peguensis, Rorippa dubia, Barringtonia acutangula, Samanea saman, Spathodea sp., Aegle marmelos and Convolvulus* sp. (Table 8).

In addition, we have found a few pollen grains of *Polygonum plebeium*, only in the indoor environment of hospital which were not recorded from any other sites including the outdoor environment.

The qualitative analysis of pollen morphotypes of the four exposure sites reveals that the maximum number of pollen morphotypes common to outdoor environment were present in the laboratory environment followed by the hospital and library environments (Table 8).

Quantitatively weekly total pollen frequency of outdoor environment showed maximum correlation with that of the hospital environment (see Table 8).

Among the pollen morphotypes recorded from outdoor and indoor sites 32 pollen types are allergenic as reported by Shivpuri and Dua (1963), Shivpuri and Singh (1971), Chanda and Mandal (1981). Percentage of various allergenic pollen grains at the three indoor environment as compared to their outdoor frequency is given in Table 9.

TABLE :9 Percentage of airborne pollen at different indoor sites as compared to their outdoor frequency during Feb-April 1992.

PLANT NAME	SITES	FEB(%)	MAR(%)	APR(%)
1	LIB	-	1	4
	LAB	2	-	18
HOLOPTELEA INTEGRIFOLIA (A)	HOS	9	12	13
2.	LIB	-	1	3
	LAB	3	2	24
RICINIUS COMMUNIS (A)	HOS	1	11	17
3.	LIB	2	18	94
	LAB	2	12	347
PINUS ROXBURGHII (A)	HOS	-	6	65
4.	LIB	3	3	5
	LAB	13	5	15
POACEAE (A)	HOS	22	12	24
5.	LIB	-	-	-
	LAB	-	-	2
MADHUCA LONGIFOLIA	HOS	-	-	1
6.	LIB	-	25	-
	LAB	-	-	2
AZADIRACHTA INDICA (A)	HOS	-	100	3
7.	LIB	-	9	-
	LAB	-	-	2
PONGAMIA PINNATA	HOS	-	32	-
8.	LIB	-	1	-
	LAB	-	1	1
DRYPETES ROXBURGHII (A)	HOS	1	5	2
9.	LIB	5	8	7
CHENOPODIACEAE/	LAB	3	10	17
AMARANTHACEAE (A)	HOS	8	13	6

PLANT NAME	SITES	FEB(%)	MAR(%)	APR(%)
10.	LIB	-	-	-
	LAB	-	-	-
ZEA MAYS	HOS	6	8	5
11.	LIB	2	3	-
	LAB	2	1	18
BRASSICA SP (A)	HOS	3	11	18
12.	LIB	-	-	-
	LAB	5	-	14
CARYOTA URENS	HOS	1	2	-
13.	LIB	-	-	-
	LAB	6	-	40
AILANTHUS EXCELSA (A)	HOS	26	22	140
14.	LIB	-	-	-
	LAB	-	-	-
TYPHA AUSTRALIS	HOS	*	-	3
15.	LIB	-	-	-
	LAB	-	-	3
POLYALTHIA LONGIFOLIA (A)	HOS	-	-	2
16.	LIB	-	1	1
	LAB	-	3	-
PARTHENIUM HYSTEROPHORUS (A)	HOS	1	15	13
17.	LIB	15	92	-
	LAB	48	50	12
OTHER ARECACEAE	HOS	39	42	2
18.	LIB	-	-	-
	LAB	2	3	*
CASUARINA EQUISETIFOLIA	HOS	-	4	-

PLANTNAME	SITES	FEB(%)	MAR(%)	APR(%)
19.	LIB	-	-	-
	LAB	-	-	-
PROSOPIS JULIFLORA (A)	HOS	-	6	5
20.	LIB	-	-	-
	LAB	-	-	12
EMBLICA OFFICINALIS	HOS	-	*	19
21.	LIB	-	13	-
	LAB	150	4	33
PLANTAGO SP	HOS	-	2	-
22.	LIB	-	-	-
	LAB	-	-	55
PHOENIX SYLVESTRIS (A)	HOS	-	-	-
23.	LIB	-	60	*
	LAB	-	-	*
OTHER NONOCOTYLEDONS	HOS	-	50	*
24.	LIB	-	6	-
	LAB	-	13	200
OTHER ASTERACEAE	HOS	20	-	200
25.	LIB	-	-	-
	LAB	-	-	4
CANNABIS SATIVA (A)	HOS	-	-	-
26.	LIB	-	-	-
	LAB	-	-	8
FERONIA LIMONIA	HOS	-	-	-
27.	LIB	-	5	-
	LAB	-	5	-
EPHEDRA FOLIATA	HOS	-	-	-

PLANT NAME	SITES	FEB(%)	MAR(%)	APR(%)
28.	LIB	-	-	-
	LAB	33	10	*
CALLISTEMON CITRINUS (A)	HOS	-	-	*
29.	LIB	-	-	25
	LAB	-	-	-
MANGIFERA INDICA	HOS	-	-	-
30.	LIB	*	*	28
	LAB	*	-	22
ARACEAE	HOS	*	*	17
31.	LIB	-	-	-
	LAB	-	-	7
GNAPHALIUM SP.	HOS	-	-	-
32.	LIB	-	-	-
	LAB	-	-	-
BOMBAX CEIBA	HOS	*	47	*
33	LIB	-	-	-
	LAB	33	*	*
THUJA / CUPRESSUS	HOS	-	-	-
34.	LIB	-	-	-
	LAB	-	-	-
CYPERACEAE (A)	HOS	-	40	-
35.	LIB	-	-	-
PTEROSPERMUM	LAB	200	33	67
ACERIFOLIUM	HOS	100	33	-
36.	LIB	-	-	-
	LAB	-	-	-
CAJANAS CAJAN	HOS	100	20	-

PLANT NAME	SITES	FEB(%)	MAR(%)	APR(%)
37.	LIB	-	-	-
	LAB	-	-	50
OTHER APIACEAE	HOS	-	-	-
38.	LIB	-	100	-
	LAB	-	50	-
PHLOX DRUMMONDII	HOS	-	-	-
39.	LIB	-	-	-
	LAB	-	-	50
PITHECELLOBIUM DULCE (A)	HOS	-	-	200
40.	LIB	-	-	-
	LAB	50	-	*
SOLANACEAE	HOS	100	-	*
41.	LIB	-	*	-
	LAB	-	-	-
ALTERNANTHERA SESSILIS (A)	HOS	-	-	-
42.	LIB	-	-	-
	LAB	-	-	-
POLYGONUM PLEBEIUM	HOS	-	-	*
43.	LIB	-	-	*
	LAB	-	-	-
TOONA CILIATA	HOS	-	*	*
44.	LIB	-	-	-
	LAB	-	-	-
MORACEAE / URTICACEAE (A)	HOS	-	-	*
45.	LIB	-	-	-
	LAB	-	*	-
SYZYGIUM CUMINI (A)	HOS	-	-	-

PLANT NAME	SITES	FEB(%)	MAR(%)	APR(%)
46.	LIB	-	-	-
	LAB	-	-	-
OTHER MALVACEAE	HOS	*	-	*
47.	LIB	-	*	-
	LAB	-	-	-
JUSTICIA SP	HOS	-	-	-
	LIB	19	3	14
	LAB	44	29	61
UNIDENTIFIED GRAINS	HOS	7	65	44
	LIB	2	2	2
	LAB	4	3	9
TOTAL	HOS	5	12	6

(A) - Reported to be allergenic.

Pollen present in the indoor envirnoment but not recovered from the outdoor environment during the corresponding period (See table 8).

High or low percentage of pollen grains in indoor environments as compared to their ourdoor frequency do not correspond to their quantum of frequency.

Statistical analysis was possible only for the following five allergenic pollen morphotypes as they were present in relatively higher numbers in indoor environments.

Holoptelea integrifolia- pollen grains of *Holoptelea integrifolia* were found in dominating numbers in all the three environments showing a peak during March (Fig. 30). Among the three indoor environments, hospital showed maximum number of *Holoptelea* while library environment showed minimum number of grains.

As compared to the number of pollen grains recorded in the outdoor environment up to 18% of outdoor *Holoptelea* entered the indoor environment.

The weekly frequencies of pollen grains of *Holoptelea* recorded from outdoor environment showed maximum correlation coefficient with those recorded from the laboratory environment (r = 0.84910) and then with the hospital environment (r = 0.78425/also see Table 10).

Pinus roxburghii - Among the three indoor environments pollen grains of *Pinus roxburghii* were found in maximum numbers in the laboratory environment and minimum in the hospital environment. In the outdoor survey the peak was observed in the 4th week of February while in the indoor surveys peaks were observed during late March (library and hospital) and early April (laboratory see Fig. 30). In the 3rd and 4th week of February pollen grains of *Pinus roxburghii* were found in high numbers ranging from 286-768 and only a few entered the indoor environments but in the last week of March and 1st and 2nd week of April the frequency of indoor *Pinus* pollen grains increased (Table 8 Fig. 30). It is thus possible that the relative high frequency of *Pinus* pollens grain inside the indoor environment may be due to the fact that the infiltrated pollen grains of *Pinus* continued to remain in the indoor environment for a long period.

Table : 10 Correlation coefficient between outdoor and dominant indoor allergenic pollen morphotypes

Plant Name	Site A (Library)	Site B (Laboratory)	Site C (Hospital)
Holoptelea integrifolia	0.49108	0.84910	0.78425
Ricinus communis	-0.38112	0.48785	-0.06022
Pinus roxburghii	0.29357	-0.05362	-0.22177
Poaceae	0.45695	-0.28781	-0.10911
Chenopodiaceae - Amaranthaceae	0.14786	0.29779	0.31623
Total Pollen Grains	0.24508	0.30117	0.72427

The weekly frequency of outdoor pollen grains of *Pinus* showed a positive correlation only with that of library environment (r = 0.29357, Table 10).

Ricinus communis- Pollen grains of *Ricinus communis* were found in significant number from hospital and laboratory environments but in stray numbers from the library environment. They showed peak in 3rd week of February in the outdoor and the laboratory sites while in the hospital environment the peak was observed in the 1st week of March (Fig. 3).

As compared to the outdoor frequency up to 24% of pollen grains of *Ricinus* entered the indoor environment (Table 30).

Weekly incidence of pollen grains of *Ricinus* recorded from the outdoor site showed a positive correlation only with that of the laboratory environment (r = 0.48785, Table 10).

Poaceae - Among the three indoor environments hospital environment showed higher number of pollen grains of Poaceae as compared to laboratory environment while in the library environment they were found in minimum number. They showed peaks during March in the outdoor and hospital sites and during April in the library & laboratory sites (Fig. 30).

As compared to the outdoor frequency the frequency of the pollen grains of Poaceae in the indoor atmosphere was 3% to 24% (Table 8).

Weekly incidence of pollen grains of Poaceae recorded from outdoor environment showed a positive correlation only with that of library site (r = 0.45695, Table 10).

Chenopodiaceae - Amaranthaceae - The total pollen catch of Chenopodiaceae - Amaranthaceae in the indoor environments of the laboratory and the hospital atmosphere was almost equal while the library environment showed

relatively a lower count. In the library, hospital and outdoor sites the peaks were observed during the month of March while in the laboratory site the peak was observed in early April (Fig. 30).

The percentage frequency of pollen grains in indoor environments as compared to outdoor environment varied from 3% to 17% (Ta ble 8).

Out-door incidence of pollen grains of Chenopodiaceae - Amaranthaceae complex showed maximum correlation coefficient with that of hospital (r = 0.31623, Table 10).

Indoor environment of hospital ward showed the highest penetration of pollen grains (5-12%) followed by laboratory (3-9%) and then the library environment (2%). The relative high pollen counts in hospital ward may be attributed to its situation on the first floor and exposure may be through the windows. The laboratory site has exposure to the surrounding vegetation through the doors and a window which opens out in the garden. The library, though situated close to the laboratory, is in-side the main building of the department at the first floor and it does not have a direct ventilation to the outside atmoshpere. Low infiltration of pollen inside the library environment may thus be due to its closed nature.

The present study reveals that the indoor environments have a low concentration of pollen grains. However, the dominant pollen morphotypes of the outdoor environment like *Holoptelea integrifolia, Pinus roxiburghii, Ricimus communis* and those of Poaceae and Chenopodiaceae- Amaranthaceae showed relatively higher frequency in indoor environments and they constituted the major allergenic pollen components of the indoor environments during Ferbruary to April. Among them pollen grains of *Holoptelea integrifolia* showed maximum correlation indices with the outdoor environment (r = 0.49108 to 0.84910, Table 10). It may be concluded that the magnitude of outdoor aeropollen concentration, the period of study

and the location and structure of the building are the important factors for indoor quality of air.

TABLE : 11 CORRELATION OF AIRBORNE POLLEN CONCENTRATIONS WITH WEATHER PARAMETERS IN SOME MONTHS OF THE YEAR 1990-91

MONTHS	MAXIMUM TEMPERATURE	MINIMUM TEMPERATURE	MEAN TEMPERATURE	RAINFALL	WINDSPEED	RELATIVE HUMIDITY
February	+0.077071	-0.089221	-0.016582	+0.048729	-0.29075	-0.29789
March	+0.20150	+0.26053	+0.24633	-0.078545	-0.54586	-0.032308
April	-0.37380	-0.10389	-0.27151	-0.24326	-0.36073	-0.031391
September	+0.068231	+0.17683	+0.11008	-0.37879	-0.21942	-0.31416
October	+0.19703	+0.45502	+0.48171	+0.49048	-0.48330	+0.31528

Correlation of airborne pollen grains with meteorological parameters

Statistical analysis was used to determine relationship between pollen concentrations and six selected weather variables . Daily pollen counts recorded during September 1990 to August 1991 were correlated with maximum temperature, minimum temperature, mean temperature, rainfall, wind speed and relative humidity.

Pollen frequency showed a positive correlation with wind speed (+0.1074) and relative humidity (+ 0.0403) and negative correlation with maximum, minimum and mean temperatures (-0.0248, -0.0974 and -0.0686 respectively) and also with rainfall (-0.0519) (Table below)

	Maximum Temperature	Minimum Temperature	Mean Temperature	Rainfall	Wind speed	Relative Humidity
Total Pollen Grains	-0.0248	-0.0974	-0.0686	-0.0519	+0.1074	+0.0403

Daily pollen counts of February, March, April, September and October were individually correlated with weather parameters of corresponding months as these months recorded maximum number of pollen grains (Table 11.).

It was observed that in February pollen counts had significant correlation with wind speed and relative humidity. Windspeed was positively correlated(+0.25075) while relative humidity showed negative correlation(-0.29789).

In March, daily pollen counts had a positive correlation with maximum, minimum & mean temperatures and wind speed (+0.20150, +0.26053, +0.24633 and +0.54586 respectively) while in April pollen concentrations

TABLE : 12 CORRELATION CO-EFFICIENTS OF COMMON AIRBORNE POLLEN TYPES AS COMPARED WITH DIFFERENT METEOROLOGICAL PARAMETERS

PLANT NAME	MAXIMUM TEMPERATURE	MINIMUM TEMPERATUR	MEAN TEMPERATURE	RAINFALL	WINDSPEED	RELATIVE HUMIDITY
1. *Caryota urens*	+0.032683	-0.075186	-0.015034	-0.074581	+0.20758	+0.027290
2. Amaranthaceae / Chenopodiaceae	-0.29143	-0.271147	-0.30324	-0.073721	-0.022549	-0.061796
3. *Ailanthus excelsa*	-0.057308	-0.017537	-0.040289	-0.067486	+0.24845	-0.079165
4. *Azadirachta indica*	-0.29782	-0.16164	-0.23947	-0.10370	-0.090235	-0.051502
5. Poaceae	+0.069134	+0.20252	+0.15097	-0.035285	-0.10396	+0.15787
6. *Drypetes roxburghii*	-0.27555	-0.26770	-0.28569	-0.038011	+0.00055969	+0.18284
7. *Holoptelea integrifolia*	-0.29040	-0.33538	-0.32639	-0.020102	+0.021775	+0.15743
8. *Madhuca longifolia*	-0.27564	-0.33047	-0.31767	-0.028893	+0.047056	+0.12463
9. *Parthenium hysterophorus*	-0.076100	-0.22174	-0.16920	-0.027652	-0.11836	-0.12421
10. *Polyalthia longifolia*	-0.55609	-0.48969	-0.55501	0.00	-0.16470	-0.045874
11. *Pongamia pinnata*	-0.68860	-0.68626	-0.73453	0.00	+0.029254	-0.27438
12. *Ricinus communis*	-0.085179	-0.091508	-0.091827	+0.0050446	+0.12279	+0.086008
13. *Typha australis*	+0.18120	+0.13217	+0.16057	-0.14155	-0.091618	-0.22347
14. *Pinus roxburghii*	-0.27357	-0.29290	-0.29619	+0.20880	-0.033133	+0.18474

showed negative correlation with maximum and mean temperature (-0.37380 & -0.27151), rainfall (-0.24326) and wind speed (-0.36073). Correlation coefficients in the month of September revealed significant negative correlation with rainfall and relative humidity (-0.37879 and -0.31416 respectively). In October, a strong positive correlation was observed with different weather variables viz. minimum and mean temperatures (+0.45502, +0.48171), rainfall (+0.49048), windspeed (+0.48330) and relative humidity (+0.31528).

Individual correlation of some common airborne pollen types with weather variables was also made (Table 12.).

Ailanthus excelsa showed a significant positive correlation with wind speed (+ 0.24845) while pollen grains of Amaranthaceae-Chenopodiaceae presented significant negative correlations with maximum, minimum and mean temperatures (-0.29143, -0.27147, -0.30324).

The aeropollen of *Azadirachta indica* showed negative significant correlation with maximum and mean temperatures (-0.29782, -0.23947). In the case of *Caryota urens* a significant positive correlation was noted with wind speed (+0.20758). A negative significant correlation was shown by

Drypetes roxburghii with maximum, minimum and mean temperatures (-0.27555, -0.26770, -0.28569) while there was a positive correlation with other factors.

In *Holoptelea integrifolia* significant negative correlation was seen with maximum, minimum and mean temperatures (-0.29040, - 0.33538, - 0.32639). Similarly in *Madhuca longifolia* correlation was negative and significant with maximum, minimum and mean temperatures (-0.27564, - 0.33047, - 0.31767).

Parthenium hysterophorus had a negative significant correlation with minimum temperature (-0.22174). A significant negative

correlation was evident in the case of *Pinus roxburghii*, with maximum, minimum & mean temperatures (-0.27357, - 0.29290, - 0.29619) and positive with rainfall (+0.20880). Aerial polen of Poaceae had a significant positive correlation only with minimum temperature (+0.20252).

Polyalthia longifolia had a negative correlation with the various parameters, being highly significant with maximum, minimum & mean temperatures (-0.55609, - 0.48969, - 0.55501). A highly significant negative correlation was seen between maximum, minimum & mean temperatures (0.68860, - 0.68626, - 0.73453).

In *Typha australis* correlation was significant with relative humidity only (-0.27438).

The present study reveals low correlation coefficient values of daily pollen counts of the whole year as compared to daily counts of individual months and common morphotypes which were significantly higher.

Windspeed along with temperature were found particularly responsible for the variation in airborne pollen concentrations. Rainfall and humidity had an inverse effect on the airborne pollen catches, however in October slight increase in humidity and rainfall increased the number of aerial pollen, particularly those belonging to the herbaceous taxa.

Allergenic significance of airborne pollen grains

During the present work 91 pollen morphotypes were identified from the atmosphere of Allahabad, out of which 39 types were found to be allergenically significant as reported by Chandra (1984) at Allahabad, Nair & Rastogi (1963) at Lucknow, Singh & Shivpuri (1971) at Delhi, Bhattacharya et al (1984) at Salt Lake City and Kundu et al (1985) at Calcutta.

Among them those present in significantly high numbers in the atmosphere of Allahabad were those belonging to Amaranthaceae - /Chenopodiaceae, *Ailanthus excelsa, Azadirachta indica, Brassica, Callistemon citrinus, Drypetes roxburghii, Holoptelea integrifolia, Madhuca longifolia, Parthenium hysterophorus*, Poaceae, *Polyalthia longifolia, Ricinus communis* and *Typha australis*. These morphotypes constitute the major components of the atmosphere of Allahabad.

Based on the period of occurrence in the atmosphere they can be categorized into two groups. The first category are of those allergenically significant pollen which are present in the air throughout the year although in varying frequencies viz. pollen of Amaranthaceae - Chenopodiaceae, *Parthenium hysterophorus, Callistemon citrinus* and members of Poaceae which are present in appreciable numbers for greater part of the year. A second category can be described of those allergenic pollen morphotypes which are present for a shorter span of time although in high numbers, viz., *Azadirachta, Brasscia, Drypetes, Holoptelea, Polyalthia, Ricinus, Typha* and *Ailanthus*, which occur mainly during the period January to May.

Certain other allergenic pollen morphotypes have been recovered, although their frequency being low and occurrence sporadic . These were pollen of *Acacia, Alternanthera, Argemone, Artemisia, Bombax, Cannabis, Cassia, Casuarina, Coriandrum, Coronopus, Croton, Eucalyptus, Feronia, Iberis,*

Mangifera, Morus, Ocimum, Prosopis, Parkinsonia, Pithecelobium, Rumex, Spergula, Tamarindus, Terminalia, Toona and *Xanthium.*

Incidence of Pteridophytic and Bryophytic spores in the atmosphere

The pteridophytic and bryophytic spores are sparse in occurrence in the atmosphere represented by only a few types (Tables 13, 14). A total of 24 pteridophytic spores were recovered from the air survey during the 1990-91 (LNS) while during 1991-92 (DGS) surveys in the DGS survey 12 were trapped at site A and 8 at site B. In the survey conducted during 1991 (BST) 423 spores per cubic metre air were caught. The only spores caught in fair numbers were those of *Nephrolepis*. Maximum number of *Nephrolepis* spores were caught during the 1991 survey (BST) when 403 spores/m^3 air were trapped while during the 1991-92 survey 5 were reported from site A and 4 at site B. Apart from this a single spore of *Lygodium* and *Christella* were trapped from site B and site A respectively. *Nephrolepis* spores were prevalent in the air from September to April. The abundance of these spores in the air can be attributed to their common cultivation as an ornamental fern at Allahabad (Table 13).

The bryophytic spores represented in the atmosphere were those of *Riccia* spp. Of these *Riccia frostii* was the most commonly represented, 6 in the 1990-91 (LNS) survey, 35 spores/m^3 air were caught in the 1991 (BST) survey, and in the 1991-92 survey, 2 were caught at site A and 4 at site B. *Riccia crystallina* spores were caught exclusively in the 1990-91 survey when a single spore was recorded and the BST survey where 7 spores/m^3 were trapped. The bryophytic spores were present in the atmosphere of Jannuary to April. Their apperance in atmosphere can be attributed to their abundant presence in moist places at Allahabad (table 14).

TABLE : 13 **AIRBORNE PTERIDOPHYTIC SPORES AT ALLAHABAD**

Spore type	Survey	Site	Year	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Tota
Lygodium	LNS	A	Sept 1990 - 91 Aug	-	-	-	-	-	-	-	-	-	-	-	-	-
	DGS	A	Feb 1991 - 92 Jan	-	-	-	-	-	-	-	-	-	-	-	-	-
	DGS	B	Feb 1991 - 92 Jan	-	-	-	1	-	-	-	-	-	-	-	-	1
	BST	A	Jan - Dec 1991	-	-	-	-	-	-	-	-	-	-	-	-	-
Nephrolepis	LNS	A	Sept 1990 - 91 Aug	-	-	2	10	9	-	-	-	-	-	-	-	21
	DGS	A	Feb 1991 - 92 Jan	-	1	-	1	-	-	1	-	-	-	2	-	5
	DGS	B	Feb 1991 - 92 Jan	-	-	1	-	1	2	-	-	-	-	-		4
	BST	A	Jan - Dec 1991	7	-	7	7	170	28	92	92	-	-	-	-	403 m
Christella	LNS	A	Sept 1990 - 91 Aug	-	-	-	-	-	-	-	-	-	-	-	1	1
	DGS	A	Feb 1991 - 92 Jan	-	-	-	-	-	-	-	-	-	-	-	-	-
	DGS	B	Feb 1991 - 92 Jan	-	-	-	-	-	-	-	-	-	-	-	-	-
	BST	A	Jan - Dec 1991	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified	LNS	A	Sept 1990 - 91 Aug	-	-	-	-	1	-	-	-	-	-	-	1	2
	DGS	A	Feb 1991 - 92 Jan	-	3	-	-	-	-	-	1	-	-	1	-	5
	DGS	B	Feb 1991 - 92 Jan	-	-	1	-	1	-	1	-	-	-	-	-	3
	BST	A	Jan - Dec 1991	7	-	-	14	-	-	-	-	-	-	-	-	21 m
TOTAL	LNS	A	Sept 1990 - 91 Aug	-	-	2	10	10	-	-	-	-	-	-	2	24
	DGS	A	Feb 1991 - 92 Jan	-	4	-	1	2	-	1	1	-	-	3	-	12
	DGS	B	Feb 1991 - 92 Jan	-	-	2	1	-	2	1	-	-	-	2	-	8
	BST	A	Jan - Dec 1991	-	-	7	21	170	28	92	92	-	-	-		423 m

LNS = Lakhanpal & Nair sampler, DGS = Durham Gravimetric sampler, BST = Burkard spore trap

TABLE : 14 **AIRBORNE BRYOPHYTIC SPORES AT ALLAHABAD**

Spore types	Survey	Site	Year	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Tota
Riccia frostii	LNS	A	Sept 1990 - 91 Aug	-	-	-	-	1	-	3	-	1	1	-	-	6
	DGS	A	Feb 1991 - 92 Jan	-	-	-	-	1	-	1	-	-	-	-	-	2
	DGS	B	Feb 1991 - 92 Jan	1	-	-	-	-	2	-	1	-	-	-	-	4
	BST	A	Jan - Dec 1991	-	-	-	-	7	14	7	7	-	-	-	-	35 m
Riccia crystallina	LNS	A	Sept 1990 - 91 Aug	-	-	-	-	-	-	-	1	-	-	-	-	1
	DGS	A	Feb 1991 - 92 Jan	-	-	-	-	-	-	-	-	-	-	-	-	-
	DGS	B	Feb 1991 - 92 Jan	-	-	-	-	-	-	-	-	-	-	-	-	-
	BST	A	Jan - Dec 1991	-	-	-	-	7	-	-	-	-	-	-	-	7 m^{-3}
Unidentified	LNS	A	Sept 1990 - 91 Aug	-	-	-	-	-	-	-	-	-	-	-	-	-
	DGS	A	Feb 1991 - 92 Jan	-	-	-	-	-	-	-	-	-	-	-	-	-
	DGS	B	Feb 1991 - 92 Jan	-	-	-	-	-	-	-	-	1	-	-	-	1
	BST	A	Jan - Dec 1991	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	LNS	A	Sept 1990 - 91 Aug	-	-	-	-	1	-	3	1	1	1	-	-	7
	DGS	A	Feb 1991 - 92 Jan	-	-	-	-	1	-	1	-	-	-	-	-	2
	DGS	B	Feb 1991 - 92 Jan	-	-	-	-	-	2	-	1	1	-	-	-	4
	BST	A	Jan - Dec 1991	-		-	-	14	14	7	7	-	-	-	-	42 m^{-3}

LNS = Lakhanpal & Nair sampler, **DGS = Durham Gravimetric sampler,** **BST = Burkard spore trap**

Incidence of airborne fungal spores

A study of atmospheric fungal spores was done along with that of pollen grains and other bioelements. Considering all the bioelements together the abundance of fungal spores in the air is outstanding. The fungal airspora concentrations made up a prominent percentage of the total airborne bioelements recorded in the atmosphere of Allahabad, much greater than that of the airborne pollen grains.

Survey I. 1990-91 Site A

During the present survey conducted with a Lakhanpal & Nair sampler at site A, a total of 42545 fungal spores were caught on the exposed slides. The airspora concentration was maximum in the months of April when 10140 (23.8%) fungal spores were recorded, and minimum were in August with 998 (2.34%) spores. A high percentage of fungal spores were also recorded in March (6571 spores, 15.4%), followed by February (4834 spores, 11.36%). The airspora percentages in other months were: September 9.98% (4249 spores), October 9.77% (4159 spores), May 7.01% (2983 spores), December 4.8% (2069 spores), November 4.65% (1979 spores), June 3.5% (1484 spores) and July 3.04% (1294 spores) (Table 15).

October was qualitatively a richer month recording maximum spore types followed by December with 22 types, September and March (21 types), November (19 types), February, April, May and July (18 types) January (17 types) and June & August (16 types)

Out of the 30 fungal spore types identified during the present survey *Alternaria* was the most dominant spore type of the atmosphere of Allahabad recording 31.07%. Next in abundance were sterile hyphal fragments (11.85%) followed by *Curvularia* (9.36%), *Epicoccum* (8.14%), *Aspergillus*-

TABLE : 15 MONTHLY TOTALS OF AIRBORNE FUNGAL SPORES DURING 1990-91

FUNGAL TYPES	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTAL	PERCENTAGE
1. ALTERNARIA	263	180	130	204	414	1522	2618	4663	1680	840	472	233	13219	31 07
2. AMPR * COMPLEX	199	166	361	106	57	1095	875	309	78	23	35	98	3402	7.99
3. BELTRANIA	4	1	-	-	-	-	-	-	-	-	-	-	5	0.01
4. BISPORA	13	36	-	3	-	-	-	20	-	-	-	-	72	0.17
5. CERCOSPORA	-	4	-	-	-	-	39	6	-	-	-	-	49	0.12
6 CHAETOMIUM	440	88	-	-	-	-	-	-	-	11	1	3	543	1.28
7 CLADOSPORIUM	206	84	41	90	105	199	115	142	10	-	20	6	1018	2.39
8. CORYNESPORA	21	39	33	21	-	5	12	-	17	12	19	37	216	0.51
9. CURVULARIA	1108	1132	314	293	115	94	158	129	117	95	191	236	3982	9.36
10 DICTYOARTHRINIUM	-	-	-	'-	8	-	-	-	-	-	-	-	8	0.02
11. DRESCHLERA	37	9	26	70	49	21	44	13	12	61	93	37	472	1.11
12. EPICOCCUM	-	6	28	87	339	545	911	1133	373	32	11	-	3465	8.14
13. HELMINTHOSPORIUM	130	215	73	18	34	69	211	734	269	59	28	20	1860	4.37
14. HYPHAL FRAGMENTS	114	231	309	412	201	455	771	1972	97	196	227	58	5043	11.85
15. MASTIGOSPORIUM	214	517	33	19	3	-	-	-	-	-	-	3	789	1.85
16. NIGROSPORA	914	784	361	306	207	110	58	57	68	19	35	34	2953	6.94
17 PERICONIA	-	3	61	178	51	172	145	148	33	6	10	12	819	1.93
18. PHAEOTRICHOCONIS	6	-	-	-	20	199	173	141	45	-	-	-	584	1.37
19. ? PUCCINIOPSIS	76	4	7	3	-	-	-	3	-	4	-	35	132	0.31
20. RUST SPORE	2	11	44	66	92	149	277	458	122	17	. 3	-	1241	2 92
21. SMUT SPORE	5	-	33	27	73	5	-	-	-	-	-	-	143	0.34
22. SPEGAZZINIA	4	3	2	3	1	-	3	-	3	-	-	-	19	0.04
23. SPONDYLOCLADIELLA	18	12	1	2	-	6	2	-	-	-	-	-	41	0.10
24 SPORORMIA	-	1	-	3	-	-	-	-	-	-	4	-	8	0.02
25. STACHYBOTRYS	-	-	-	-	-	-	16	6	-	-	15	6	43	0.10
26. STEMPHYLIUM	-	7	-	7	-	120	55	81	6	3	6	9	294	0.69
27. SPORIDESMIUM	-	21	-	-	-	2	-	-	-	-	-	-	23	0.05
28. TETRAPLOA	7	12	2	17	3	-	9	-	3	6	9	-	68	0.1
29. TORULA	198	60	8	26	-	-	34	13	6	-	7	34	386	0.91
30. TRICHOCONIS	-	-	-	-	-	6	3	-	22	11	-	-	42	0.10
UNIDENTIFIED	270	533	112	108	13	60	42	112	22	89	108	137	1606	3.77
TOTAL	4249	4159	1979	2069	1785	4834	6571	10140	2983	1484	1294	998	42545	100.00

Mucor-Penicillium-Rhizopus complex (7.99%) and *Nigrospora* (6.94%). Spores of *Helminthosporium* (4.37%), Rusts (2.92%), *Cladosporium* (2.39%), *Periconia* (1.92%), *Mastigosporium* (1.85%), *Phaeotrichoconis* (1.37%) *Chaetomium* (1.27%) and *Dreschlera* (1.1%) were recorded in moderate frequencies (table 15).

It was interesting to note that these fungal spore types were present throughout or almost throughout the investigation period; except for *Chaetomium, Mastigosporium and Phaeotrichoconis* which showed a seasonal pattern (Figs. 34, 36, 37).

The other identified spore types were those recovered in much lower frequencies (less than 1% of total catch) and were of sporadic occurrence viz., *Beltrania, Bispora, Cercospora, Dictyoarthrinium, Pucciniopsis,* Smut spore, *Spegazzinia, Spondylocladiella, Sporormia, Stachybotrys, Stemphylium, Tetraploa, Torula and Trichoconis* (Table 15).

Survey II 1991-1992 Site A

In the survey conducted during 1991-92 at site A with the Durham gravity sampler, a total of 24545 fungal spores were caught, with the maximum occurrence in the month of April. About 24.7% of the total spore catch was recorded in this month (6061). Good amount of fungal spores were trapped also in the month of March (4732, 19.3%) followed by May when 2989 (12.16%) spores were reported. Airspora concentrations were moderate in February with 1894 (7.7%) spores, October with 1566 (6.4%), December with 1324 (5.4%), July with 1138 (4.6%), January with 1110 (4.5%), November with 1075 (4.4%), September with 1018 (4.2%), August with 905 (3.7%) and lowest in June with 738 (3%) fungal spores.(Table 16).

34 diffirent spore types were identified during the present investigation, of which, 10 types recorded more than 1% of the total catch.

TABLE : 16 MONTHLY TOTALS OF AIRBORNE FUNGAL SPORES DURING 1991-1992 AT SITES A & B

FUNGAL TYPES	SITE	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	TOTAL	PERCEN-TAGE
1. ALTERNARIA	A	462	2178	3228	1267	408	388	231	195	158	106	258	464	9343	38.06
	B	454	1248	3245	457	217	348	232	212	154	218	251	703	7739	32 86
2. AMPR COMPLEX	A	152	136	107	24	10	27	32	92	75	138	102	18	913	3.72
	B	381	217	115	13	4	-	-	50	127	262	41	59	1269	5 39
3. BELTRANIA	A	-	-	-	-	-	-	-	2	1	-	-	-	3	0.01
	B	1	-	-	-	-	-	-	-	-	-	-	-	1	0.004
4. BIPOLARIS	A	-	-	-	-	-	-	11	-	-	20	12	-	43	0 18
	B	-	5	-	3	2	32	14	17	17	14	8	8	120	0 51
5. BISPORA	A	1	-	2	-	1	-	-	-	-	-	-	-	4	0.02
	B	-	-	-	-	-	-	-	-	-	-	3	-	3	0.01
6. BOTRYODIPLODIA	A	4	1	-	-	-	1	-	25	-	-	-	-	31	0.13
	B	-	-	-	1	-	-	-	-	-	-	2	-	3	0.01
7. CERCOSPORA	A	-	5	6	4	-	1	-	3	-	-	2	-	21	0 09
	B	7	53	35	15	-	2	-	1	5	-	1	2	121	0 51
8. CHAETOMIUM	A	16	19	-	17	-	-	-	-	-	7	22	-	81	0.33
	B	-	50	55	15	2	99	6	36	11	-	22	26	322	1 37
9 CLADOSPORIUM	A	106	242	122	26	4	25	8	28	61	76	102	64	864	3 52
	B	38	21	80	·5	-	-	5	3	6	114	245	682	1199	5.10
10 CORYNESPORA	A	-	15	3	2	1	8	19	14	11	4	6	-	83	0 34
	B		-	-	4	-	10	14	30	11	-	19	13	101	0 43
11 CURVULARIA	A	116	56	90	101	47	196	177	232	370	213	102	114	1814	7 39
	B	70	69	112	66	29	238	124	371	636	121	223	148	2207	9.37
12. DICTYOARTHRINIUM	A	2	-	-	-	-	-	-	-	1	-	-	-	3	0.01
	B	-	-	-	-	-	-	-	-	-	-	2	1	3	0 01
13 DRESCHLERA	A	28	8	10	16	16	31	2	12	26	7	26	-	182	0.74
	B	11	81	33	29	18	4	3	12	3	18	50	23	258	1 21
14. EMERICELLA	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	B	-	-	-	-	-	-	-	-	-	-	34	8	42	0 18
15 EPICOCCUM	A	222	727	599	240	24	19	6	11	9	19	66	116	2058	8 38
	B	109	253	1167	39	7	8	6	2	25	51	80	147	1894	8.04
16 FUSARIUM	A	-	1	-	28	-	-	-	-	-	-	-	-	29	0.12
	B	-	-	-	-	-	4	1	4	-	-	2	-	11	0 48
17. HELMINTHOSPORIUM	A	28	114	287	161	27	47	31	35	78	9	10	13	840	3.42
	B	69	50	127	51	15	24	17	78	59	18	47	20	575	2.44
18 HYPHAL FRAGMENTS	A	336	598	1299	826	125	257	212	232	203	227	150	154	4619	18 82
	B	340	803	759	271	70	418	121	162	148	175	302	420	3989	16 94

FUNGAL TYPES	SITE	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	TOTAL	PERCEN-TAGE
19. MASTIGOSPORIUM	A	2	-	-	-	-	5	2	23	175	10	4	-	221	0 90
	B	2	-	-	-	-	-	1	21	274	11	2	7	318	1.35
20. NIGROSPORA	A	15	8	43	24	9	46	23	36	131	102	94	101	632	2.57
	B	46	32	54	5	4	20	20	72	235	87	160	155	890	3 78
21 PERICONIA	A	62	126	33	11	2	6	4	-	6	19	166	24	459	1.87
	B	7	2	4	3	-	-	-	-	-	-	5	35	56	0.24
22 PHAEOTRICHOCONIS	A	6	64	8	7	-	-	-	-	-	-	10	8	103	0.42
	B	11	16	127	6	-	-	-	-	-	-	-	17	177	0 75
23. PUCCINIOPSIS	A	-	-	6	-	-	3	21	9	-	-	-	-	39	0.16
	B	-	-	-	-	-	-	7	16	-	-	-	4	27	0.11
24. RUST SPORE	A	96	178	8	76	3	4	2	3	11	5	4	4	394	1.61
	B	63	61	291	24	2	13	1	-	12	20	51	31	569	2 42
25 SMUT SPORE	A	4	3	73	-	-	4	5	2	11	11	50	16	179	0 73
	B	6	10	173	3	2	12	9	4	12	27	119	254	631	2 68
26. SPEGAZZINIA	A	2	1	-	-	-	-	-	-	1	2	-	-	6	0 02
	B	-	-	-	-	-	-	-	-	-	-	-	1	1	0.004
27. SPONDYLOCLADIELLA	A	-	5	4	1	-	2	2	13	4	1	20	-	52	0 21
	B	-	-	2	-	-	-	-	-	-	-		-	2	0 008
28. SPORIDESMIUM	A	-	1	-	-	-	-	-	-	9	-	-	-	10	0 04
	B		-	-	-	-	-	-	12	6	-	-	-	18	0 08
29. SPOROBMIA	A	-		-	-	6	-	2		-		-	-	8	0 03
	B	-	-	-	-	-	6	3	4	-	-	1	2	16	0 07
30 STACHYBOTRYS	A	30	32	-	6	-	-	-	-	-	-	36	-	104	0 42
	B	-	-	-	-	-	-	-	-	-	-	-	69	69	0 29
31. STEMPHYLIUM	A	6	103	20	16	-	-	-	-	-	-	-	-	145	0 59
	B	32	10	94	9	2	-	-	-	-	-	-	4	151	0 64
32. TELEUTOSPORE	A	2	-	-	-	-	-	-	-	-	1	-	-	3	0 01
	B	-	2	-	-	-	-	-	-	-	-	2	-	4	0 02
33. TETRAPLOA	A	2	3	1	5	-	2	-	2	10	2	2	-	29	0 12
	B	5	-	3	2	5	2	-	-	9	-	3	7	36	0 15
34. TORULA	A	-	-	-	-	-	5	25	19	2	28	36	-	115	0.47
	B	-	-	-	-	-	2	30	18	5	10	16	2	83	0 35
35 TRICHOCONIS	A	4	4	22	7	1	-	-	-	1	-	2	-	41	0 17
	B	1	-	-	3	-	-	1	-	-	-	-	4	9	0 04
UNIDENTIFIED	A	190	104	90	119	54	61	90	30	212	68	42	14	1074	4 38
	B	13	54	68	15	69	72	26	58	31	47	75	86	614	2.61
TOTAL	A	1894	4732	6061	2984	738	1138	905	1018	1566	1075	1324	1110	24545	100
	B	1666	3037	6544	1039	448	1314	641	1183	1786	1193	1766	2938	23555	100

AMPR = ASPERGILLUS - MUCOR- PENICILLIUM - RHIZOPUS COMPLEX

Alternaria was the most dominating, constituting 38% of the total airspora; followed by hyphal fragments (18.8%). Other types were recovered in moderate frequencies viz. *Epicoccum* (8.4%), *Curvularia* (7.4%) *AMPR* complex (3.7%), *Cladosporium* (3.5%) *Helminthosporium* (3.4%), *Nigrospora* (2.6%), *Periconia* (1.9%) and Rust spores. (Table 16).

The other less common types (frequency less than 1%) were *Beltrania, Bipolaris, Bispora, Botryodiplodia, Cercospora, Chaetomium, Corynespora, Dictyoarthrinium, Pucciniopsis, Dreschlera,? Fusarium, Mastigosporium. Phaeotrichoconis,* Smut spore, *Spegazzina, Spondylocladiella, Sporidesmium, Sporormia, Stachybotrys, Stemphylium,* Teleutospores, *Tetrapola, Torula and Trichoconos.* (Table 16)

Among the 34 types identified maximum types were recovered in March (25), followed by February (24). 23 types were recorded in December, 22 in May and October, 21 in April and November, 19 in August, 15 in June and 12 in January.(Table 16)

Survey III, 1991-1992 Site B

In the atmospheric fungal spora survey of 91-92 at site B., a total of 23555 spores were trapped of which quantitative scores were maximum during April with a record of 6544 (27.8%) spores. It was followed by March with 3037 (12.9%) spores and January when 2938 (12.9%) spores were recorded. The airspora concentration in other months in descending order were as follows- October- 1786 (7.6%), December- 1766 (7.5%), February- 1666 (7.1%), July- 1314 (5.6%), September- 1183 (5.0%), November 1193 (5%), May, 1039 (4.4%) and August- 641 (2.7%).(Table 16)

Qualitatively 35 spore types were identified of which January recorded the maximum types i.e. 28 followed by December with 26 types,

May (21), September (20), February, August and October (19), March and April (18), July (17) and June & November (14).(Table 16)

The spores of *Alternaria* were predominant with 32.9% of the total airspora recorded, followed by hyphal fragments with 16.9%. The other types recovered in more than 1% were *Curvularia* (9.4%), *Epicoccum* (8.0%) AMPR complex (5.4%), *Cladosporium* (5.0%), *Nigrospora* (3.8%), smut spores (2.7%), *Helminthosporium* (2.4%), Rust spores (2.4%), *Mastigosporium* (1.4%), *Chaetomium* (1.4%) and *Dreschlera* (1.2%).(Table 16)

The rest of the identified types were recoverd in lower frequencies (less than 1%) viz. *Beltrania, Bipolaris, Bispora, Botryodiplodia, Cercospora, Corynespora, Dictyoarthrinium,? Pucciniopsis, Emericella, Fusarium, Periconia, Phaeotrichoconis, Spegazzinia, Spondylocladiella, Sporidesmium, Sporormia, Stachybotrys, Stemphylium, Teleutospore,Torula and Trichoconis*.(Table 16)

Survey IV 1991 Site A

The survey conducted with the volumetric spore trap during 1991 revealed the presence of 392,986 fungal spores m^{-3} of air. The maximum spore catch was in the month of February when 97,304 m^{-3} (24.8%) spores were recorded. An increase in the month of February was due to the abundance of *Cladosporium* spores, which were trapped in very high numbers by the Burkard spore trap. Moderate frequencies of fungal spores were recorded in March when 52453 (13.3%) m^{-3} spores were caught followed by January with 54751 m^{-3} (13.9%) spores, April with 50034 m^{-3} spores (12.4%), September with 40444 m^{-3} (10.3%) and October with 38643 m^{-3} spores (9.8%). The spore catches in other months were recorded in lower frequencies viz. 16612 m^{-3} (4.2%) in June, 12723 m^{-3} (3.2%) in July, 10673 m^{-3} (2.7) in May, 7077 m^{-3} (1.8%) in

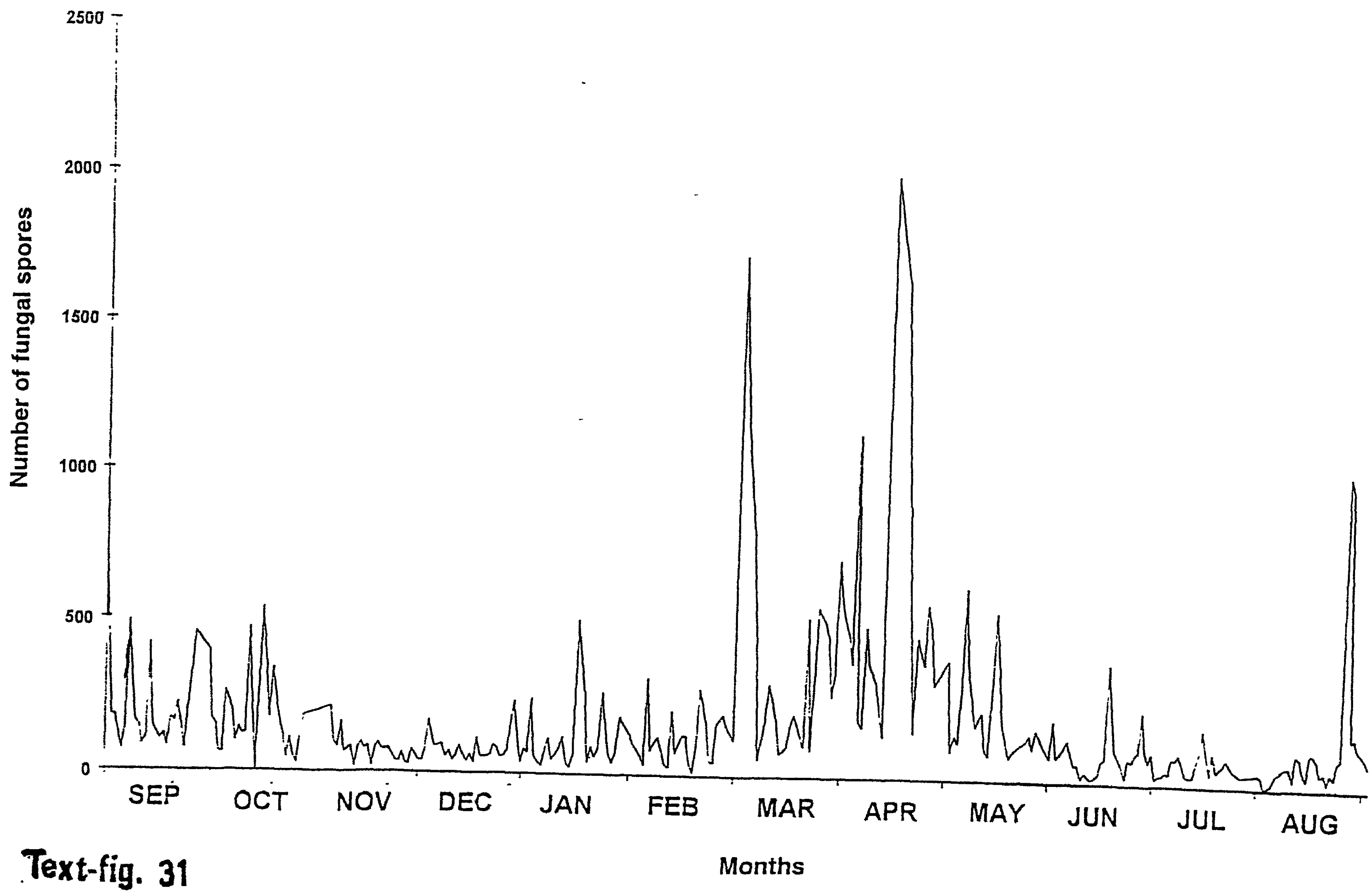
TABLE : 17 AIRBORNE FUNGAL SPORES PER CUBIC METER OF AIR DURING 1991 AT ALLAHABAD

FUNGAL TYPES	JAN	FEB	MAR*	APR	MAY*	JUN	JUL	AUG	SEP	OCT	NOV*	DEC	TOTAL	PERCENTAGE
1. ALTERNARIA	3340	7532	15574	23596	4567	8965	4539	638	2220	1830	163	723	73687	18.75
2. AMPR** COMPLEX	2567	15851	1787	3411	794	670	830	-	1539	589	92	2060	30190	7 68
3. BELTRANIA	-	7	-	-	-	-	-	-	-	-	-	-	7	0.002
4. BISPORA	-	-	-	-	-	-	-	-	-	-	-	7	7	0 002
5. B0TRYODIPLODIA	14	7	-	-	-	-	-	14	-	35	-	-	70	0.02
6. CERCOSPORA	14	64	270	78	57	21	-	7	-	702	-	-	14616	3.72
7. CHAETOMIUM	-	5929	7624	191	163	-	-	-	7	702	-	-	14616	3.72
8 CLADOSPORIUM	23759	54915	7248	745	241	2773	57	57	2071	5964	532	553	98915	25 17
9 CORYNESPORA	50	21	35	71	-	14	57	50	99	71	-	-	468	0.12
10 CURVULARIA	1475	950	1489	1461	426	1125	2177	986	7312	15957	362	936	34687	8 83
11 DICTYOARTHRINIUM	-	7	-	7	21	-	-	-	35	64	21	21	176	0 04
12 DRESCHLERA	305	43	291	298	170	99	128	-	184	78	-	50	1646	0.42
13. EPICOCCUM	11851	1674	4624	2780	1298	191	156	64	49	206	43	106	23042	5 86
14. FUSARIUM	-	163	21	-	-	-	-	57	553	-	-	-	794	0 20
15. HELMINTHOSPORIUM	348	390	610	801	149	369	262	57	1128	1014	28	28	5184	1 32
16. HIRUDINARIA	-	-	-	-	-	-	-	-	50	-	-	-	50	0.01
17 HYPHAL FRAGMENTS	7681	5986	8291	8312	2156	1241	2149	738	3149	4255	404	1177	45539	11 59
18. MASTIGOSPORIUM	14	7	-	-	-	28	-	-	411	596	-	7	1063	0.27
19. NIGROSPORA	858	376	227	326	149	206	482	199	2744	3149	305	511	9532	2.43
20. PERICONIA	135	85	674	-	7	7	-	-	7	7	-	-	922	0 23
21. PHAEOTRICHOCONIS	14	184	220	21	-	7	-	-	-	-	-	-	446	0.11
22. ?PUCCINIOPSIS	-	35	-	14	-	7	50	1206	5001	-	-	-	6313	1.61
23. ?ROSELLINA	-	-	-	-	-	-	-	-	3007	1503	4801	-	9311	2.37
24. RUST SPORE	128	213	539	411	128	-	21	-	21	28	7	28	1524	0.39
25. SMUT SPORE	496	1057	1362	213	92	43	50	21	85	163	28	64	3674	0.93
26 SPEGAZZINIA	7	21	7	-	-	-	-	7	-	7	-	-	49	0.01
27 SPONDYLOCLADIELLA	128	43	14	-	-	7	-	-	135	64	-	-	391	0.10
28 .SPORIDESMIUM	-	-	-	-	-	35	14	-	21	64	-	-	134	0.03
29 SPORORMIA	-	-	-	-	-	14	28	71	57	7	-	-	177	0 05
30. STACHYBOTRYS	-	-	-	-	-	43	-	-	35	7	7	14	106	0.03
31. STEMPHYLIUM	21	142	277	99	43	14	14	-	14	21	-	14	659	0.17
32 TETRAPLOA	14	21	7	7	-	7	21	14	28	7	-	-	126	0 03
33 TORULA	99	-	113	57	28	43	163	546	4468	496	57	85	6155	1.57
34. TRICHOCONIS	-	35	206	43	7	-	7	-	-	14	-	-	312	0.08
UNIDENTIFIED	1433	1546	943	7092	177	652	1518	844	6014	1695	227	312	23453	5.71
TOTAL	54751	97305	52453	50034	10673	16612	12723	5576	40444	38643	7077	6696	392986	100.0

* DUE OT TRAP MALFUNCTION DATA OF ONLY 5 DAYS COULD BE RECORDED IN THESE MONTHS.

** AMPR COMPLEX : ASPERGILLUS-MUCOR-PENCILLIUM-RHIZOPUS COMPLEX.

DAILY INCIDENCE OF FUNGAL SPORES IN THE ATMOSPHERE OF ALLAHABAD DURING 1990 - 91



Text-fig. 31

November, 6696 m^{-3} (1.7%) in December and lowest catch of 5576 m^{-3} (1.4%) in July.(Table 17)

34 different spore types were identified, of which, 12 were recorded in concentrations of more than 1%. *Cladosporium* was the most dominant with 25.1% of the total catch followed by *Alternaria* with 18.8%, and hyphal fragments 11.6%. Other spore types recorded in more than 1% were *Curvularia* (8.8%), AMPR complex (7.7%), *Epicoccum* (5.9%), *Chaetomium* (3.7%), *Nigrospora* (2.4%), ? *Rosellina* (2.4%), ? *Pucciniopsis* (1.6%), *Torula* (1.6%) and *Helminthosporium* (1.3%).(Table 17)

Qualitatively spores which were recorded in less than 1% were of *Beltrania, Bispora, Botryodiplodia, Cercospora, Corynespora, Dictyoarthrinium, Dreschlera, Fusarium, Hirudinaria, Mastigosporium, Periconia, Phaeotrichoconis,* Rusts, Smut, *Spegazzinia, Spondylocladiella, Sporidesmium, Sporormia, Stachybotrys, Stemphylium, Tetraploa* and *Trichoconis*.(Table 17)

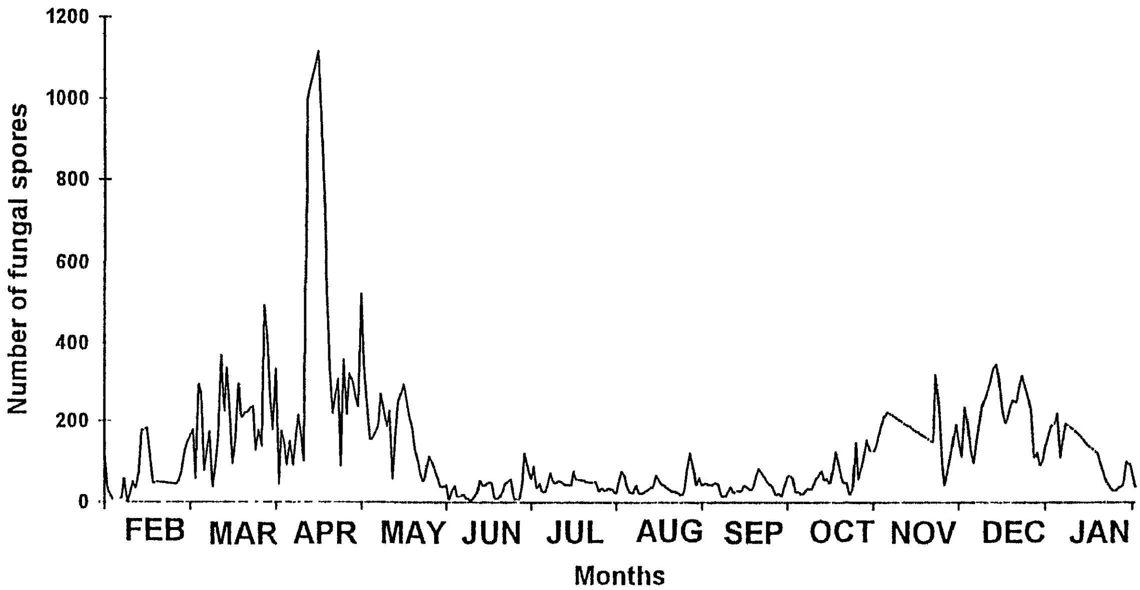
Maximum spore types were recovered in the month of October (28) followed by February and September recording 27 spore types. In the other months spore types recorded were 23 in March & June, 22 in January, 21 in April, 19 in July, 18 in May 17 in August & December and 14 in November.(Table 17)

Seasonal periodicity

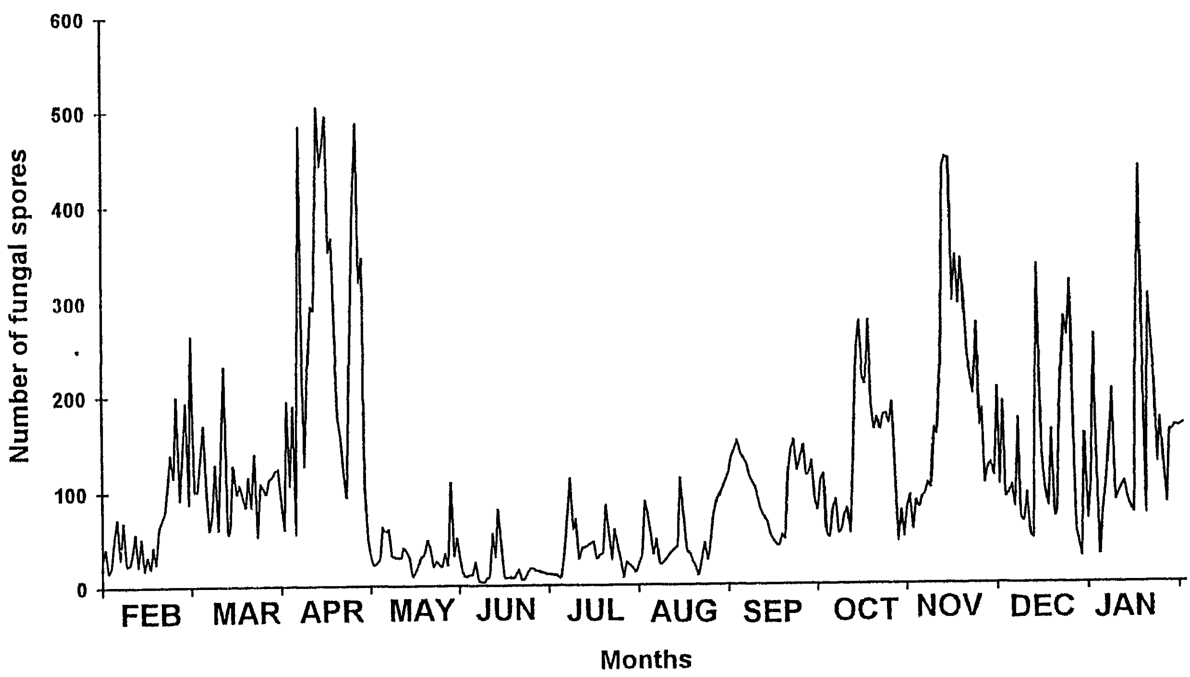
Results of the different surveys reveal that aerospora concentrations during the calendar months show seasonal variations. In general, two high frequency periods were noticed, the first during February to May and the second in the months of September to October. The dominant types recorded in the first high frequency period were *Alternaria, Helminthosporium, Aspergillus-*

DAILY INCIDENCE OF FUNGAL SPORES IN THE ATMOSPHERE OF ALLAHABAD DURING 1991 - 1992 AT

SITE A

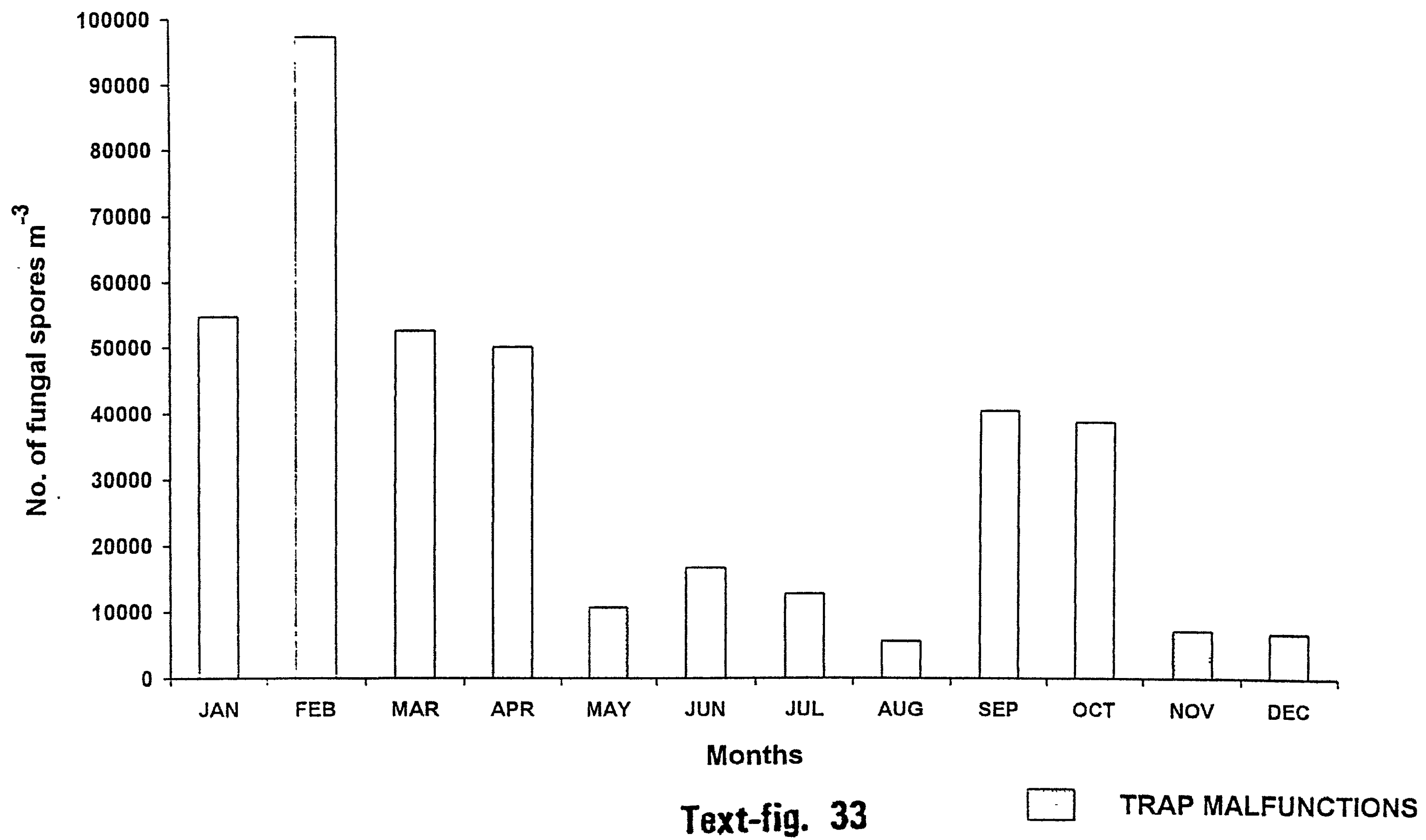


SITE B



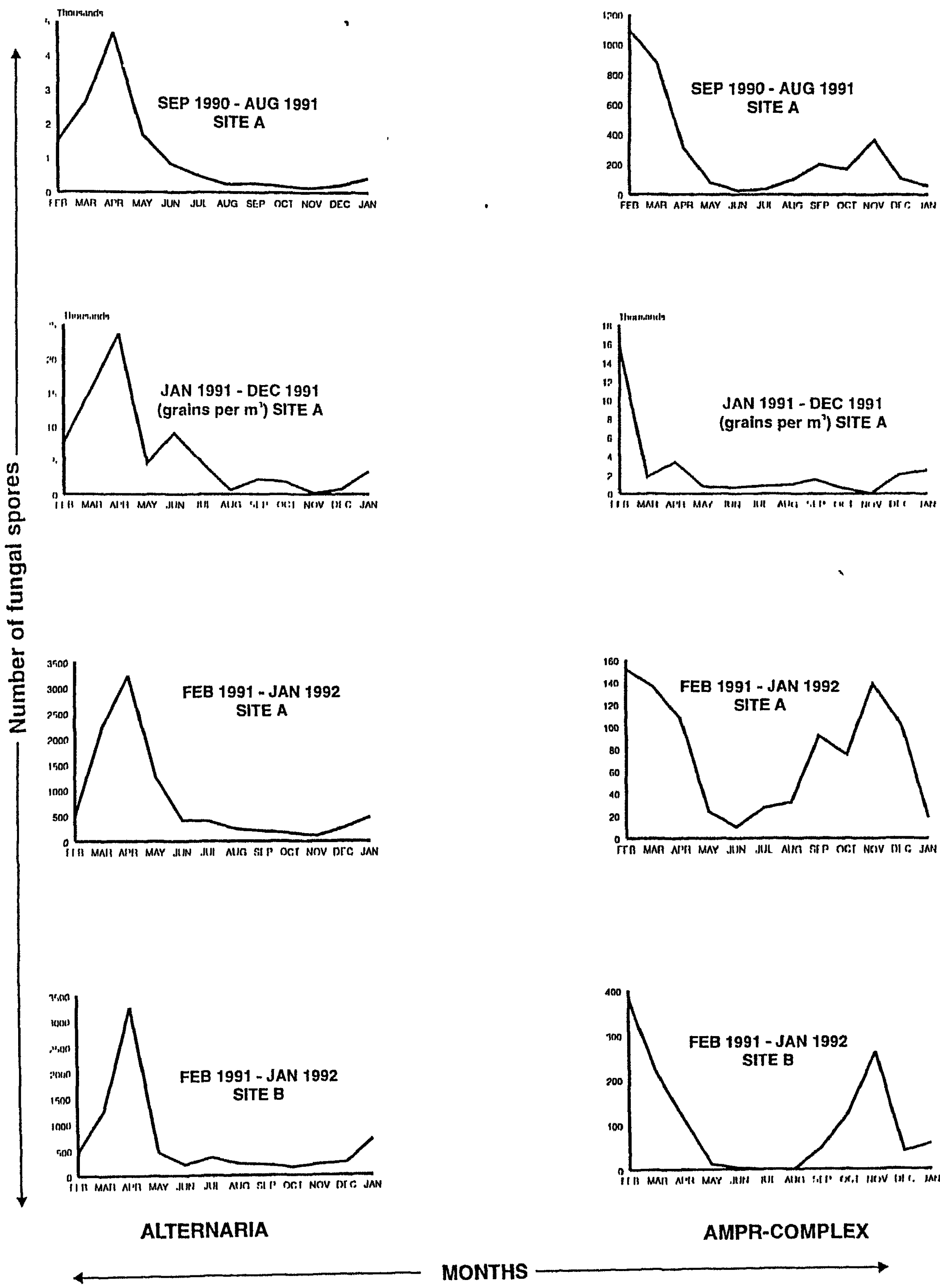
Text-fig. 32

INCIDENCE OF FUNGAL SPORES PER CUBIC METER OF AIR DURING 1991 AT ALLAHABAD



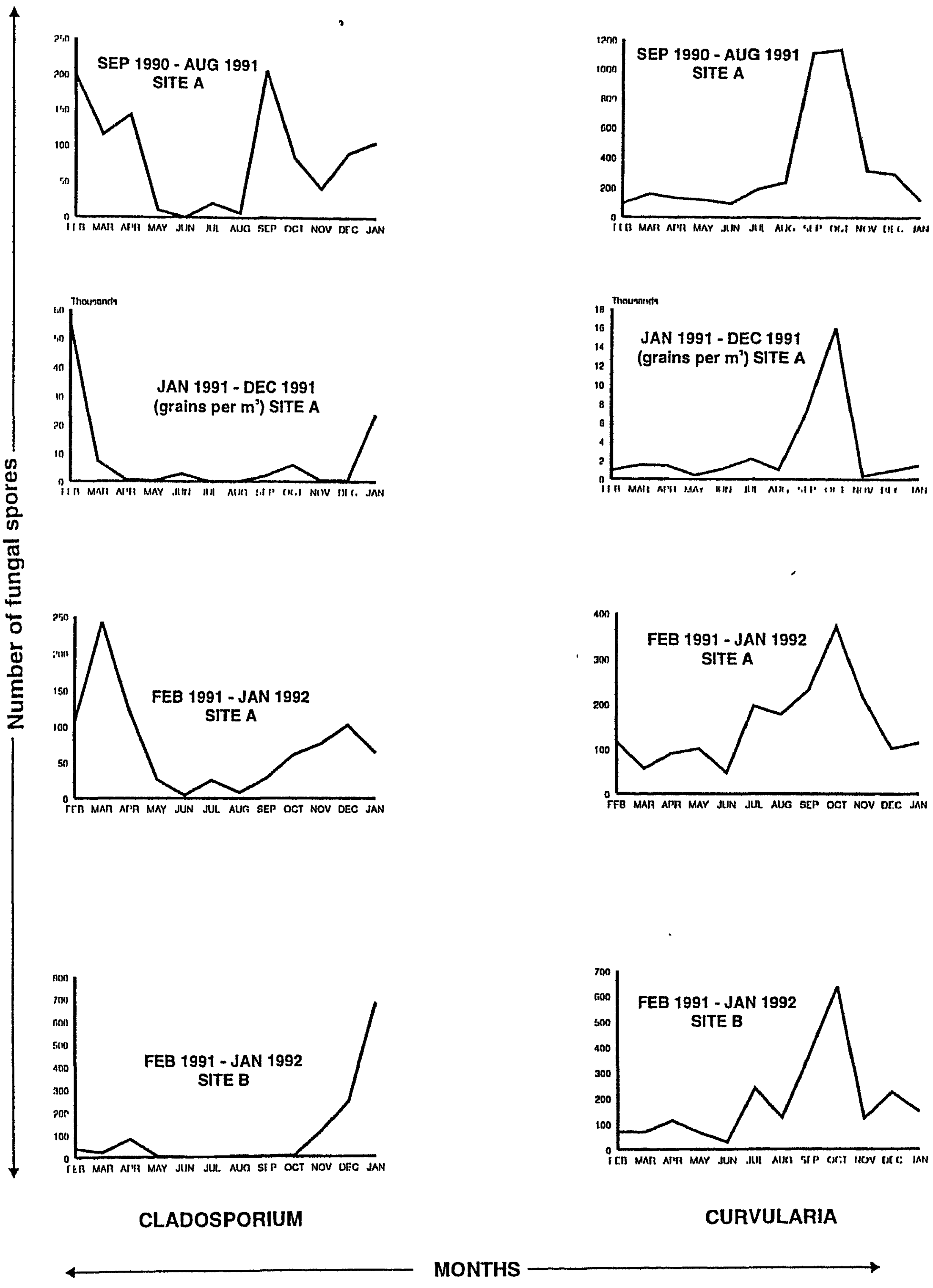
Text-fig. 33

MONTHLY INCIDENCE OF COMMON AIRBORNE FUNGAL SPORE TYPES IN THE ATMOSPHERE OF ALLAHABAD



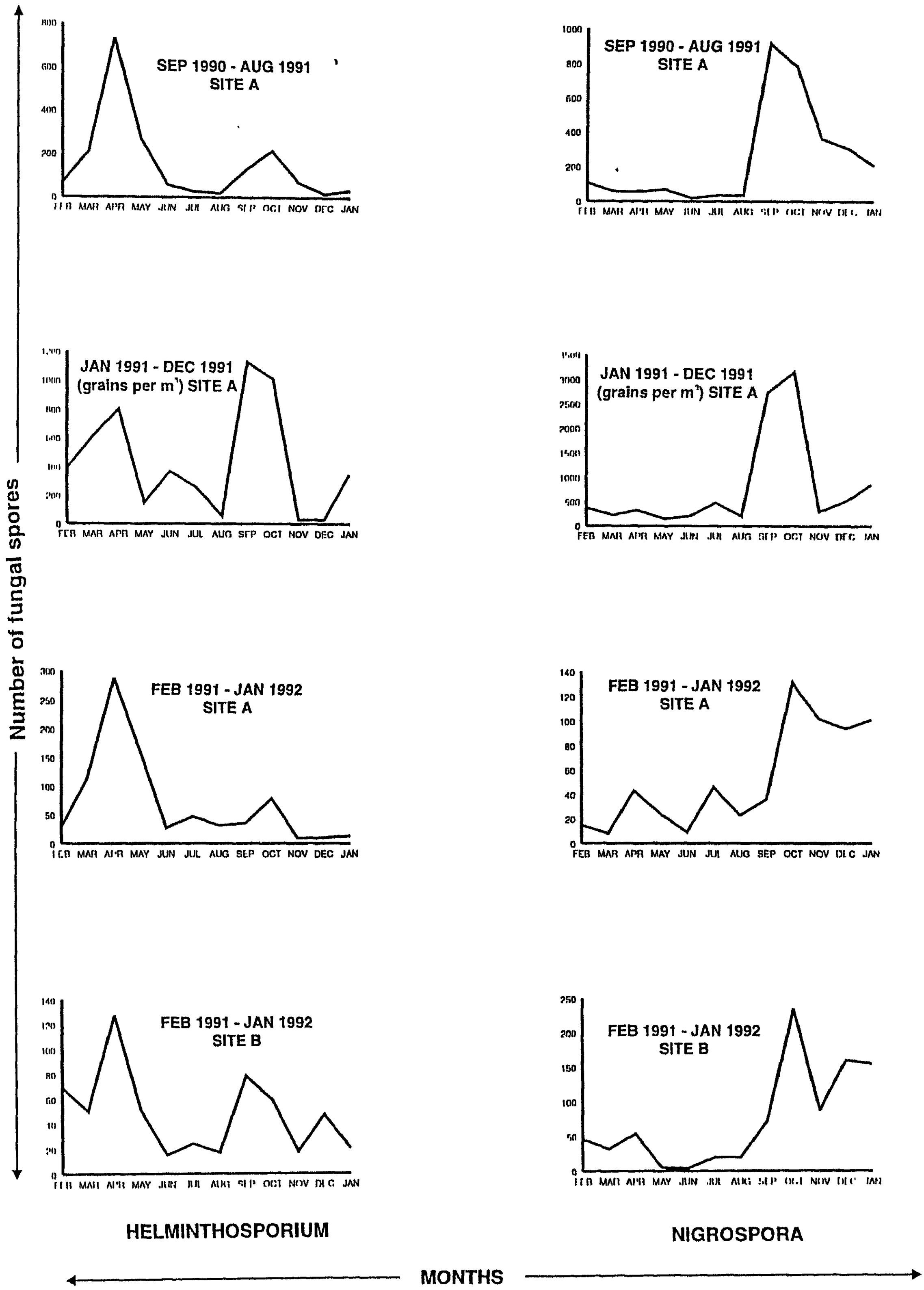
Text-fig. 34.

MONTHLY INCIDENCE OF COMMON AIRBORNE FUNGAL SPORE TYPES IN THE ATMOSPHERE OF ALLAHABAD



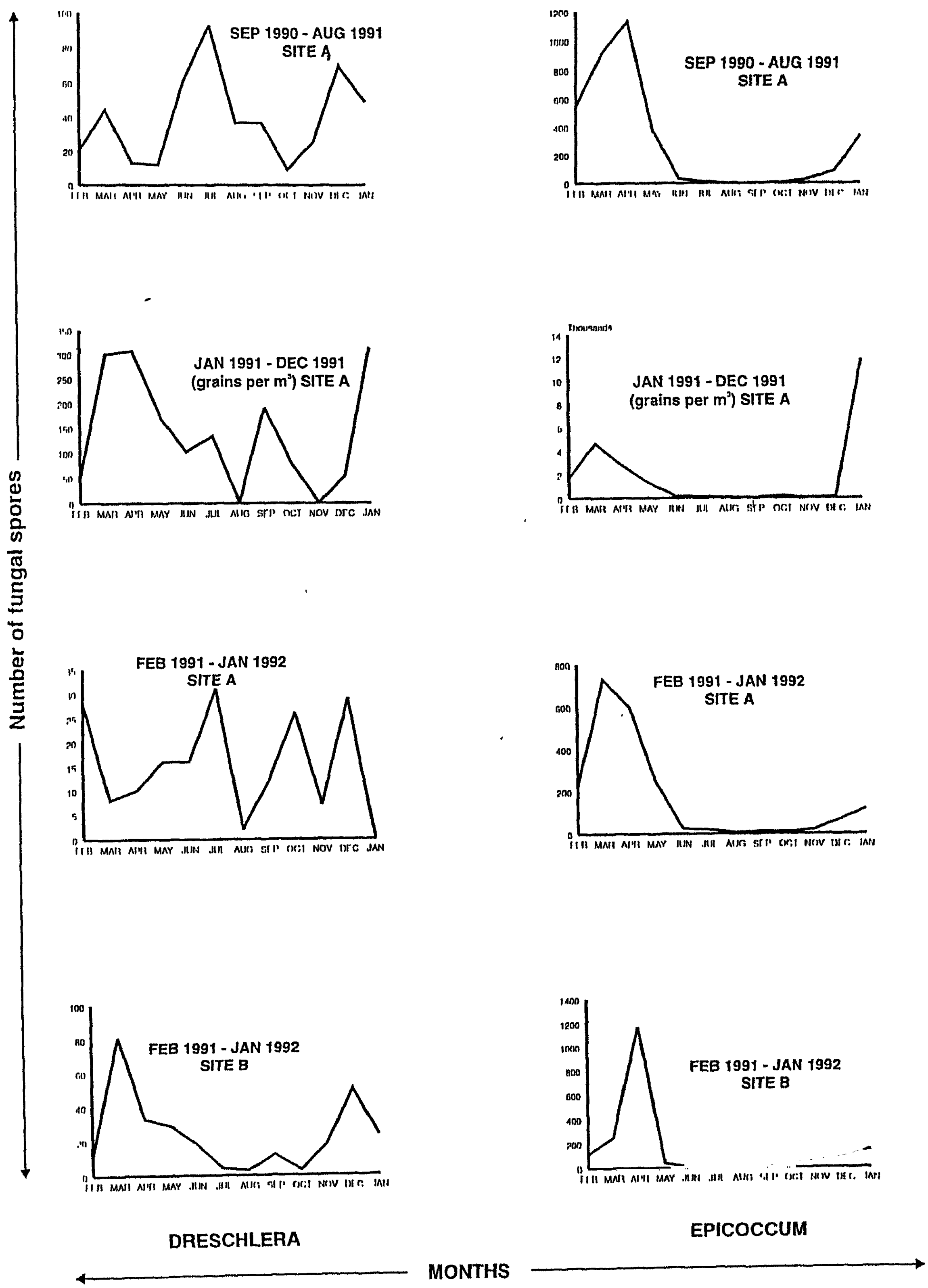
Text-fig. 35

MONTHLY INCIDENCE OF COMMON AIRBORNE FUNGAL SPORE TYPES
IN THE ATMOSPHERE OF ALLAHABAD



Text-fig. 36

MONTHLY INCIDENCE OF COMMON AIRBORNE FUNGAL SPORE TYPES IN THE ATMOSPHERE OF ALLAHABAD



Text-fig. 37

Mucor-Penicillium-Rhizopus complex, *Chaetomium, Cladosporium, Epicoccum*, Rust and Smut spores while during September-October, spores of *Curvularia, Nigrospora, Mastigosporium, ? Pucciniopsis, Torula and Periconia.*

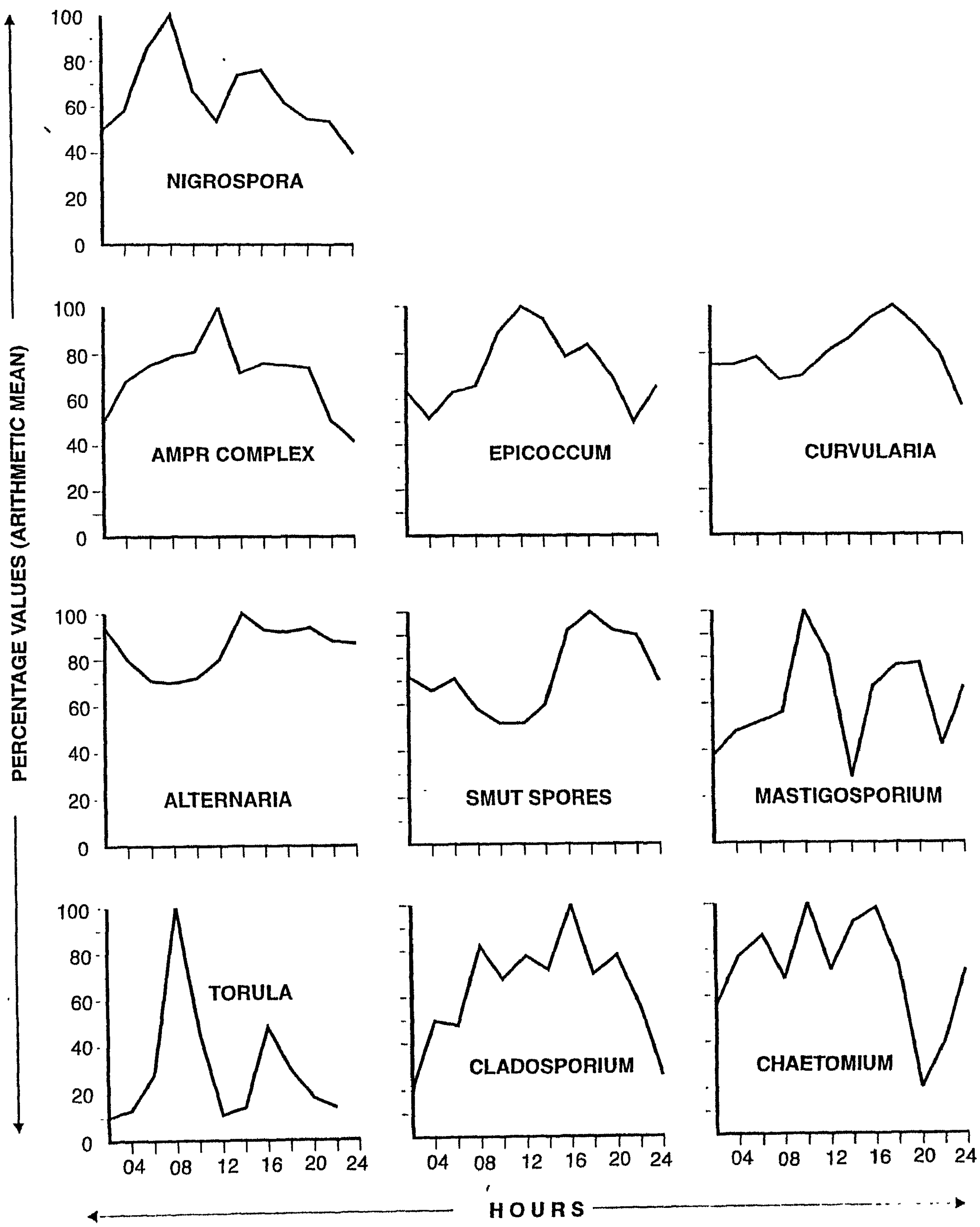
A low frequency period was observed during June to August and a moderate to low frequency period during November to January when comparatively lower frequencies of fungal spores were observed.

Out of the 35 spore types identified from the atmosphere 13 spore types were recovered throughout or almost throughout the investigation year viz. *Alternaria*, AMPR complex, *Cladosporium, Curvularia, Dreschlera, Epicoccum, Helminthosporium. Nigrospora, Periconia*, Rust and Smut spores, *Trichoconis* and *Torula*. The remaining types were recorded for shorter durations.(Figs. 34, 35, 36, 37).

Alternaria was the most dominant genus of the atmosphere of Allahabad in three of the surveys conducted with the gravimetric spore traps; while in the survey conducted with the volumetric spore trap, spores of *Cladosporium* (25.2%) dominated, followed by those of *Alternaria* (18.8%).(Figs. 34, 35) This could be due to the increased efficiency of the volumetric spore trap for trapping small sized spores like *Cladosporium* (Gregory 1961, Maribhat & Rajasab 1989). The maximum peak of *Alternaria* occurred in the month of April making upto 18-38% of the total airspora.(Fig 34) Next in dominance was *Curvularia* with a peak in the month of October.(Fig 35) These three major airspora components viz. *Alternaria, Cladosporium and Curvularia* did not show any definite seasonal patterns.

Helminthosporium spores, showed peak in the month of April but in the BST survey the peak was observed during September.(Fig. 36) *Mastigosporium* spores were present in the air in the post-monsoon period with the peak in October. Similarly peak frequency periods of *Nigrospora* spores were

DIURNAL PERIODICITIES OF AERIAL CONCENTRATIONS OF SOME COMMON AIRBORNE FUNGAL SPORE TYPES AT ALLAHABAD



Text-fig. 38

recored during the post-monsoon months of September and October(Fig. 36). *Periconia* was abundant in the atmosphere from December to March whereas *Phaeotrichoconis* made its appearance on the exposed slides from January to May. *Cercospora* spores showed a definite seasonal pattern and were prevalent during the spring-early summer period. *Chaetomium, Dreschlera* and *Stemphylium* did not show any particular seasonal pattern either. By and large *Chaetomim* and *Stemphylium* were more common from February to April. ? *Pucciniopsis* and ? *Rosellina* showed their appearance in the atmosphere during the post monsoon months. The former showing a peak in September while the latter in November.

Among the less common types, *Spondylocladiella* made its appearance twice in the year during spring-early summer period as well as in the post monsoon period, *Sporormia* during June to September, *Torula* was dominant in the post monsoon months and *Trichoconis* from February to May.

The other spore types were recorded in much lesser frequencies to show any definite seasonal pattern.

Hyphal fragments were abundant in the air throughout the year in high frequencies but their maximum concentration was in the month of April. However they did not show any significant seasonal periodicity.

Diurnal periodicity of different fungal spore types

Airborne spore concentrations of dominant fungal types were recorded at different hours during the day. It was observed that spores of *Epicoccum, Aspergillus- Mucor- Penicillium- Rhizopus* (AMPR) complex, *Chaetomium* and *Cladosporium* showed day patterns. *Epicoccum* and AMPR complex spores showed a steady rise in their concentrations from 4.00 hrs reaching peak at 12.00 noon. More than 70% of the spore concentration occurred between 6 to 20 hrs. *Cladosporium* and *Chaetomium* spores showed concentra-

tions of more than 60% during the day hours. However, in *Cheatomium* a decrease in airspora concentrations was seen in late evening hours and in *Cladosporium* during the night hours. (Fig. 38)

A forenoon pattern was seen in *Nigrospora* with the peak occurrence at 8.00 hrs. A minor peak was also observed in the afternoon at 16.00 hrs. Spores of *Alternaria, Curvularia* and Smuts were prevalent in the atmosphere at high concentrations in the afternoon. *Alternaria* being the most dominant type showed more than 70% concentrations throughout the day with a peak at 14 hours while *Curvularia* spores showed more than 60% concentrations for greater part of the day with peak at 18 hours. Concentration of Smut spores increased from 12.00 hrs reaching peak at 18.00 hrs.(Fig. 38)

Spores of *Mastigosporium* and *Torula* showed double peaks. Peak in *Mastigosporium* occurred at 10 hrs and a minor peak at 20 hrs while *Torula* showed a major peak at 8.00 hrs and minor at 16.00 hrs.(Fig. 38)

Fungal spora concentrations in the atmosphere of two sites : A and B.

The fungal aerospora of site A and B were found to be almost similar qualitatively but there were quantitative differences in the frequencies of individual spore types at the two sites (Table 16).

Total spore concentrations were almost equivalent being 24545 at site A and 23555 at site B. Among the individual spore types recorded at both sites (34 at site A and 35 at site B), *Alternaria, Botryodiplodia, Epicoccum,* Hyphal fragments, *Periconia, Spondylocladiella, and Stachybotrys* were found to be more abundant at site A, while AMPR complex, *Cercospora, Chaetomium, Cladosporium, Corynespora, Curvularia, Dreschlera, Mastigosporium, Nigrospora, Phaeotrichoconis,* Rust and smut spores and *Bipolaris* dominated at

site B, The remaining spore types were found to be almost equivalent in their concentrations at both sites. *Emericella* was the only spore type reported exclusively at site B.(table 16)

Among the prominent spore types recorded, *Alternaria* was the most dominant at both the sites and its percentage contribution at site A was 38% while at site B 32.8%. Likewise *Curvularia* was 7.4% at site A and 9.4% at site B. followed by *Epicoccum* which was 8.4% at site A and 8% at site B. Smut and Rust spores were more prevalent in the air at site B viz; 2.4% and 2.7% respectively, than at site A where only 1.6% and 0.7% were recovered respectively. Similarly *Cladosporium and Nigrospora* too were found in greater abundance at site B (5.1% and 3.8% respectively) than at site A (3.5% and 2.6% respectively). (Table 16)

TABLE :18   AIRBORNE ALGAE AT ALLAHABAD

Algal type	Survey	Site	Year	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total	%
Aphanocapsa	LNS	A	Sept 1990 - 91 Aug	214	188	54	90	20	173	104	57	57	14	10	2	983	65.4
	DGS	A	Feb 1991 - 92 Jan	3	51	53	4	3	35	5	6	18	14	75	22	289	69.1
	DGS	B	Feb 1991 - 92 Jan	16	92	111	64	20	5	4	3	39	19	81	39	493	79.1
	BST	A	Jan - Dec 1991	120	85	14	99	99	71	305	14	-	28	7	411	1204 m^3	80.6
Gloeocapsa	LNS	A	Sept 1990 - 91 Aug	11	2	3	-	11	12	-	-	-	-	-	-	39	2.6
	DGS	A	Feb 1991 - 92 Jan	-	9	10	-	-	-	-	-	-	-	-		19	4.5
	DGS	B	Feb 1991 - 92 Jan	-	-	-	-	5	-	-	-	1	-	-	1	7	1.1
	BST	A	Jan - Dec 1991	7	7	-	-	-	-	-	-	-	-	-	-	14 m^3	2.2
Myxosarcina	LNS	A	Sept 1990 - 91 Aug	5	15	33	26	4	13	12	13	-	-	-	1	122	8.1
	DGS	A	Feb 1991 - 92 Jan	1	5	2	3	-	1	2	10	2	1	1	-	28	6.7
	DGS	B	Feb 1991 - 92 Jan	-	3	6	-	1	-	-	-	-	-	-	-	10	1.6
	BST	A	Jan - Dec 1991	-	14	-	-	-	-	7	28	28	-	-	-	77 m^3	5.2
Lyngbya	LNS	A	Sept 1990 - 91 Aug	1	-	45	23	-	19	3	3	-	-	2	-	96	6.4
	DGS	A	Feb 1991 - 92 Jan	-	6	2	-	-	4	3	2	-	3	9	-	29	6.9
	DGS	B	Feb 1991 - 92 Jan	1	2	-	24	1	3	-	-	2	1	-	8	42	6.7
	BST	A	Jan - Dec 1991	-	-	-	-	-	-	7	71	21	7	-	-	106 m^3	7.1
Scytonema	LNS	A	Sept 1990 - 91 Aug	47	40	-	9	19	8	3	9	12	-	4	-	151	10.1
	DGS	A	Feb 1991 - 92 Jan	10	7	-	5	3	1	3	1	5	3	-	-	38	9.1
	DGS	B	Feb 1991 - 92 Jan	1	-	-	42	11	-	-	-	1	1	-	-	56	9.0
	BST	A	Jan - Dec 1991	28	-	-	-	14	-	-	-	-	-	-	7	49 m^3	3.2
Unidentified	LNS	A	Sept 1990 - 91 Aug	17	8	8	2.1	5	10	-	16	3	8	13	2	111	7.4
	DGS	A	Feb 1991 - 92 Jan	-	1	2	4		2	-	-	3	1	2	-	15	3.5
	DGS	B	Feb 1991 - 92 Jan	-	1	1	4	6	1	-	2	-	-	-	-	15	2.4
	BST	A	Jan - Dec 1991	-	-	-	-	21	-	-	14	7	14	7	-	63 m^3	4.2
TOTAL	LNS	A	Sept 1990 - 91 Aug	295	253	143	169	59	235	122	98	72	22	29	5	1502	
	DGS	A	Feb 1991 - 92 Jan	14	79	69	16	6	43	13	19	28	22	87	22	418	
	DGS	B	Feb 1991 - 92 Jan	18	98	118	134	44	9	4	5	43	21	81	48	623	
	BST	A	Jan - Dec 1991	155	106	14	50	134	71	319	127	35	49	14	418	1492 m^3	

LNS = Lakhanpal & Nair sampler,   DGS = Durham Gravimetric sampler,   BST = Burkard spore trap

Airborne Algae at Allahabad

In the various surveys conducted at Allahabad during different years a total of 1502 algal fragments were caught during 1990-91 survey, while in the gravimetric surveys at Site A and Site B during 1991-92, 418 and 623 algal fragments were recorded respectively. The volumetric spore trap showed total occurrence of 1492 m^{-3}. Algal fragments during the period January to December 1991. (Table 18)

The results revealed the presence of algae in the aytmosphere all round the year although in varying frequencies. The types identified belonged to the Cyanophycean group viz. *Aphanocapsa, Gloeocapsa, Lyngbya, Myxosarcina* and *Scytonema.* Among these *Aphanocapsa* predominated and was perpetually present throughout the year, contributing 65-80% to the total algal catch in various surveys. *Scytonema* and *Lyngbya* were the only filamentous forms trapped, their frequency ranged from 3.2-10% and 1.6-8.1% respectively. Besides *Aphanocapsa*, other colonical forms viz., *Gloeocapsa* and *Myxosarcina* contributed, 1-4.5% and 6.4-7% to the total aerophycoflora in different surveys. It was found that the algal types represented in the atmosphere were of common occurrence in the flora of Allahabad. (Table 18)

CHAPTER - V

BIBLIOGRAPHY

BIBLIOGRAPHY

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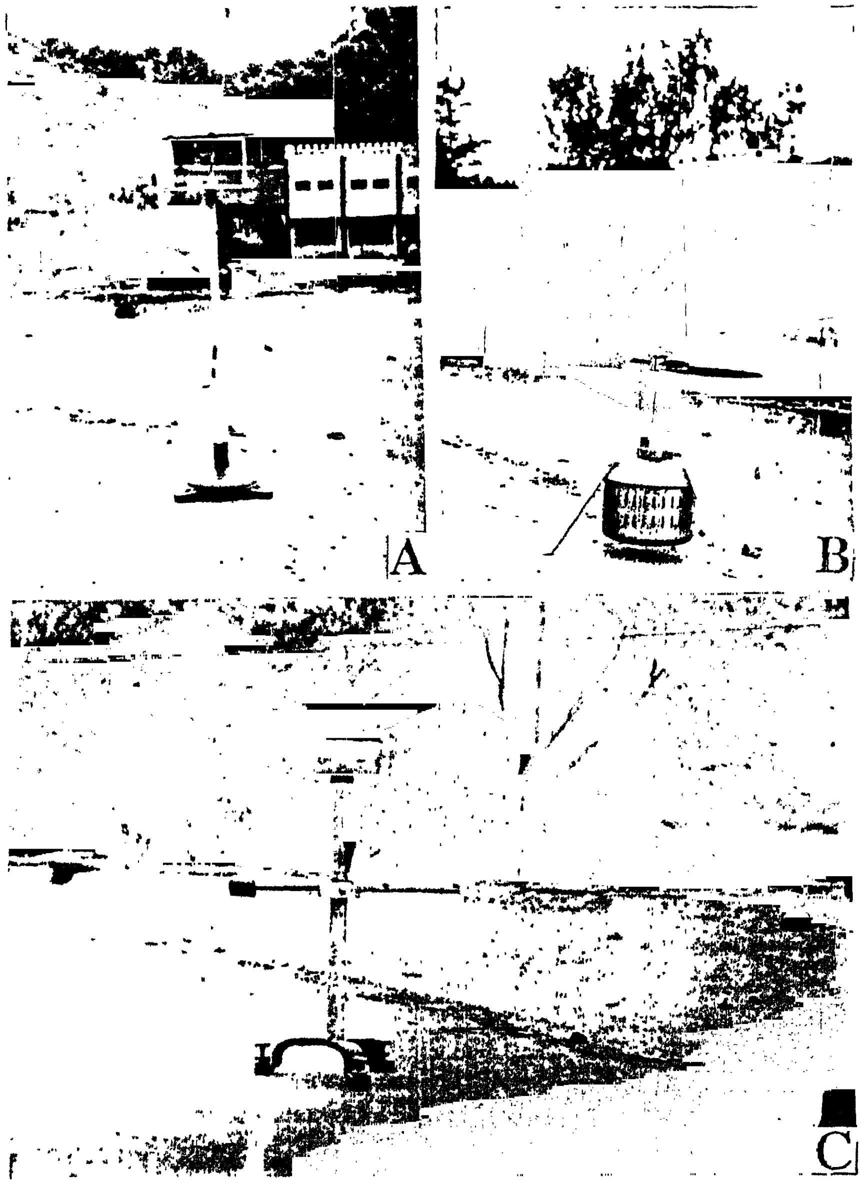

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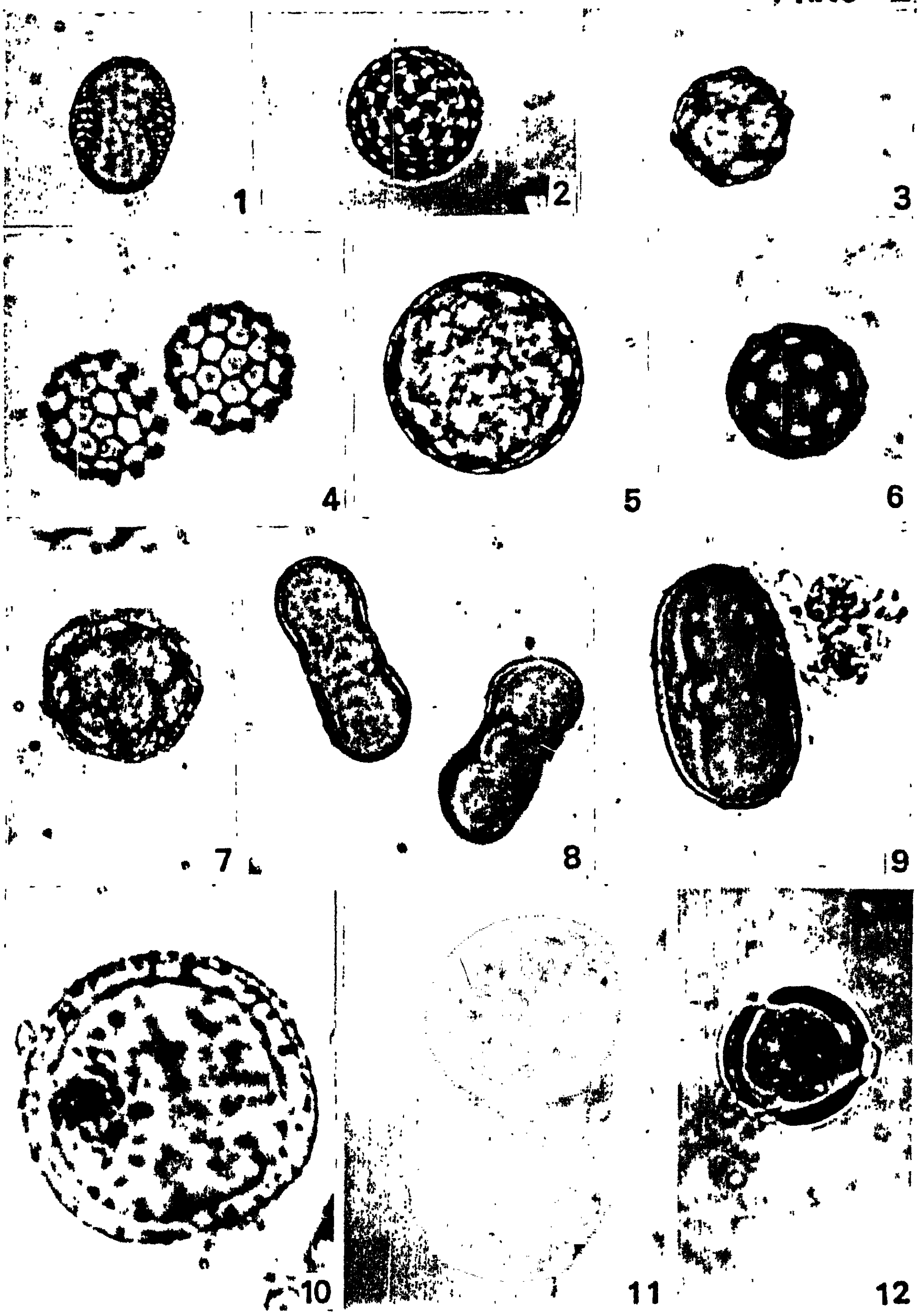

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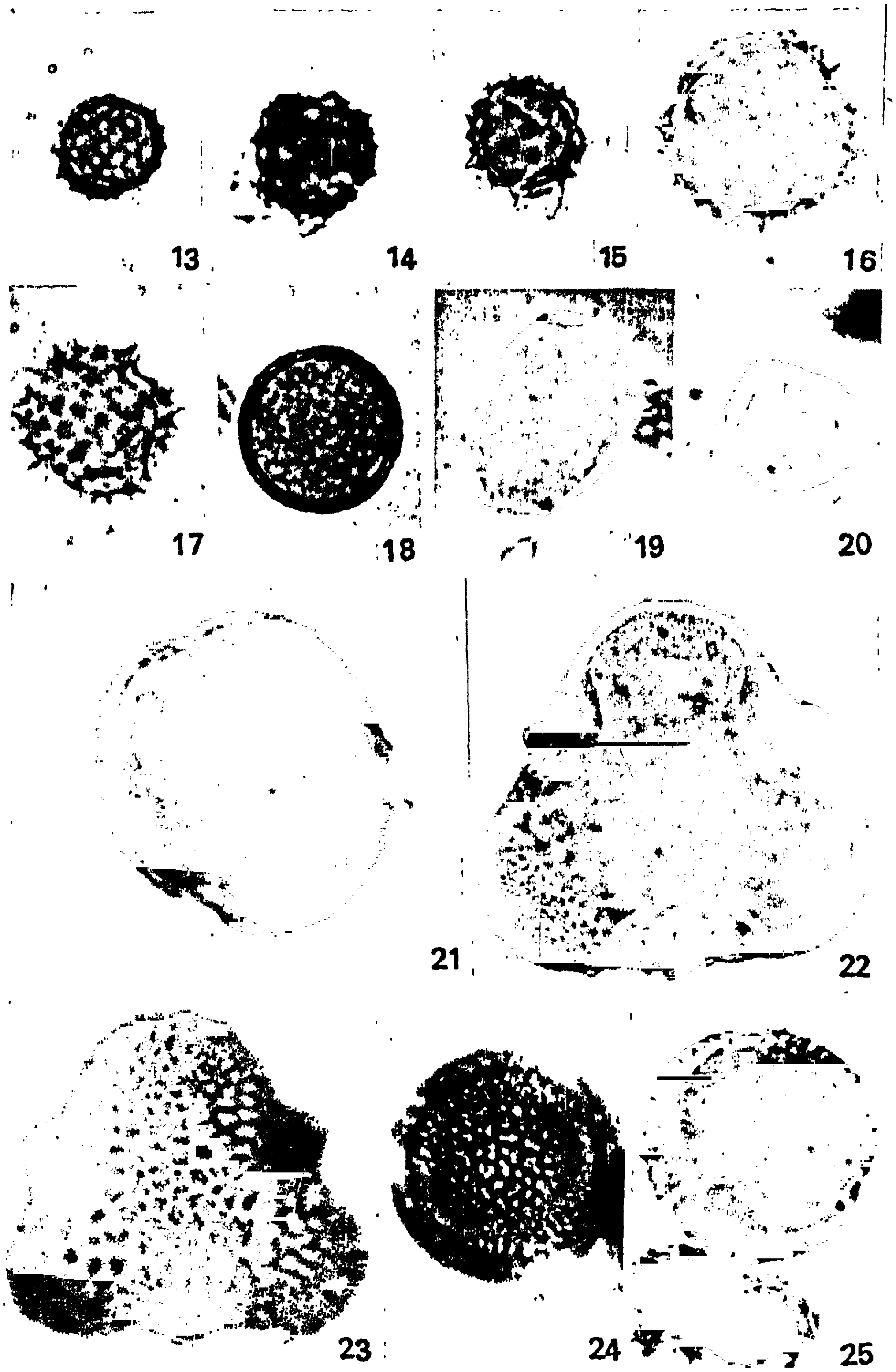

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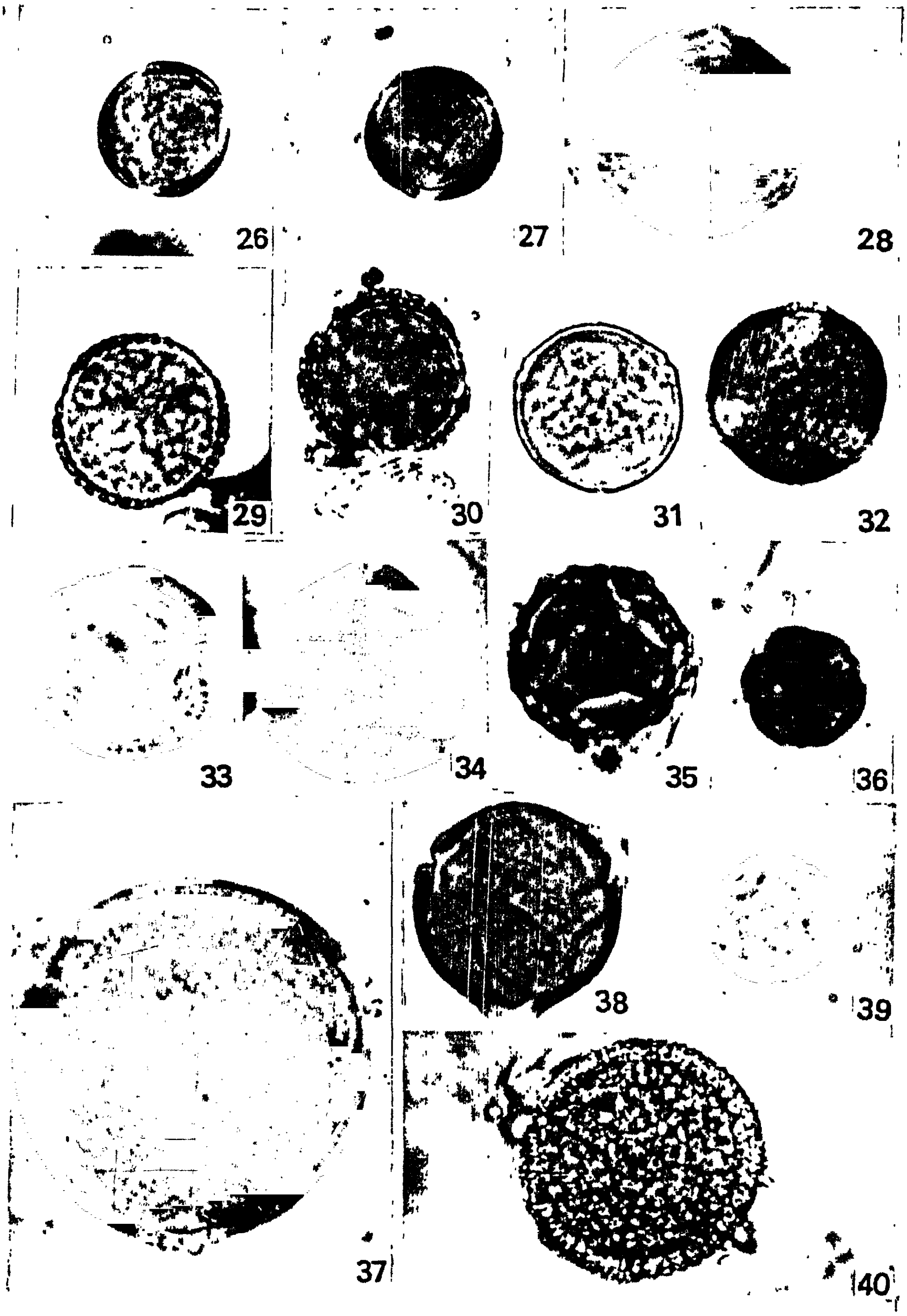

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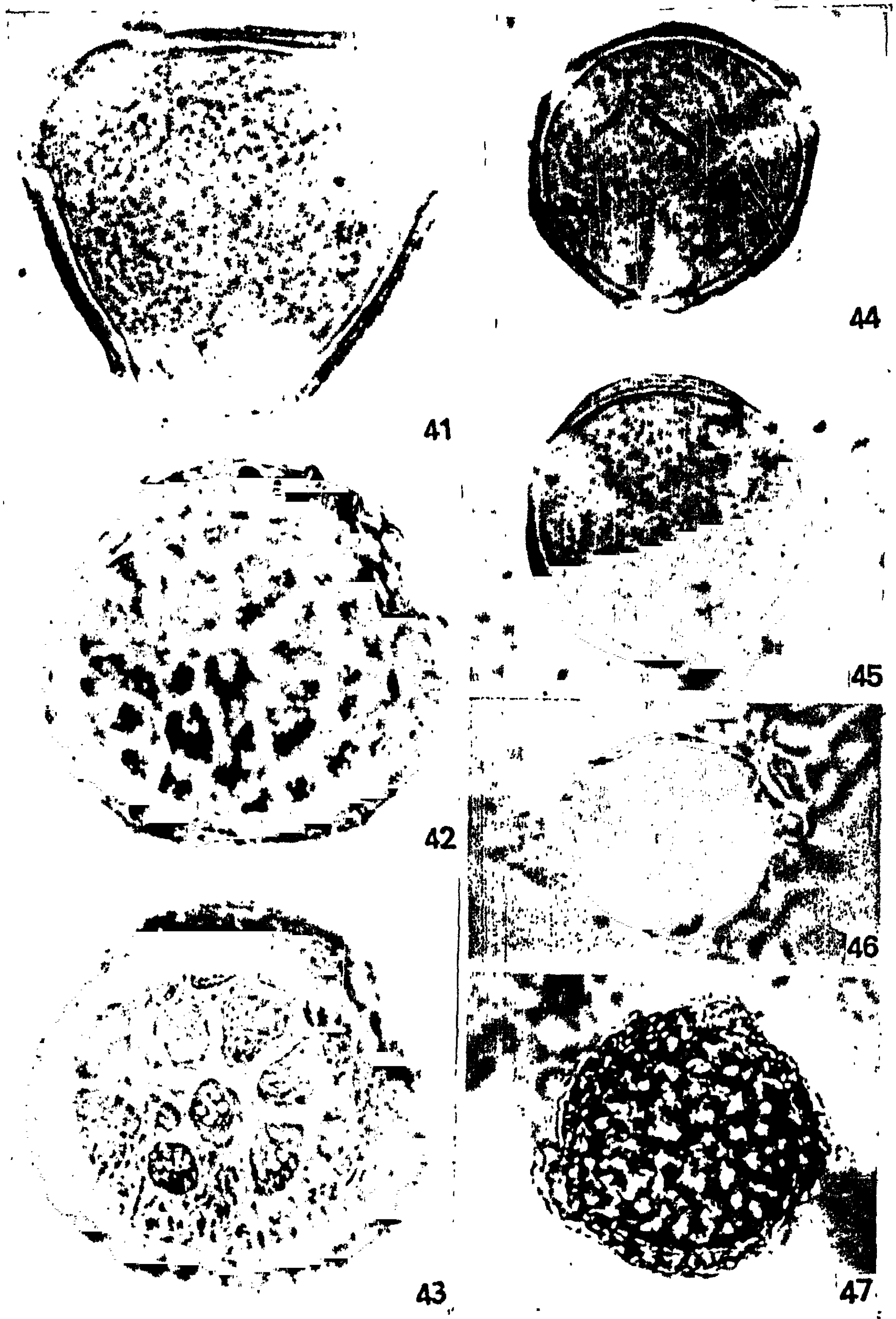

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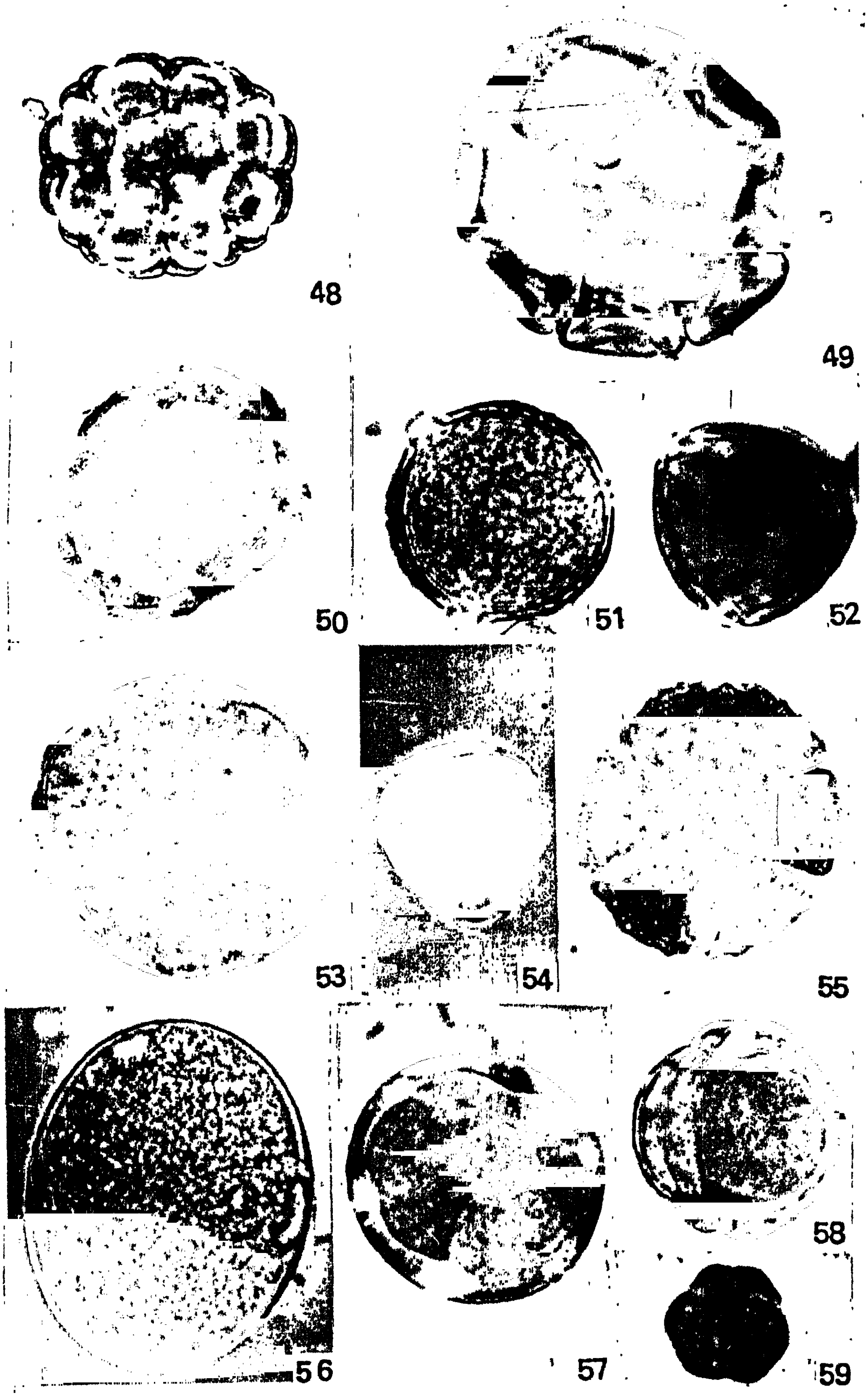

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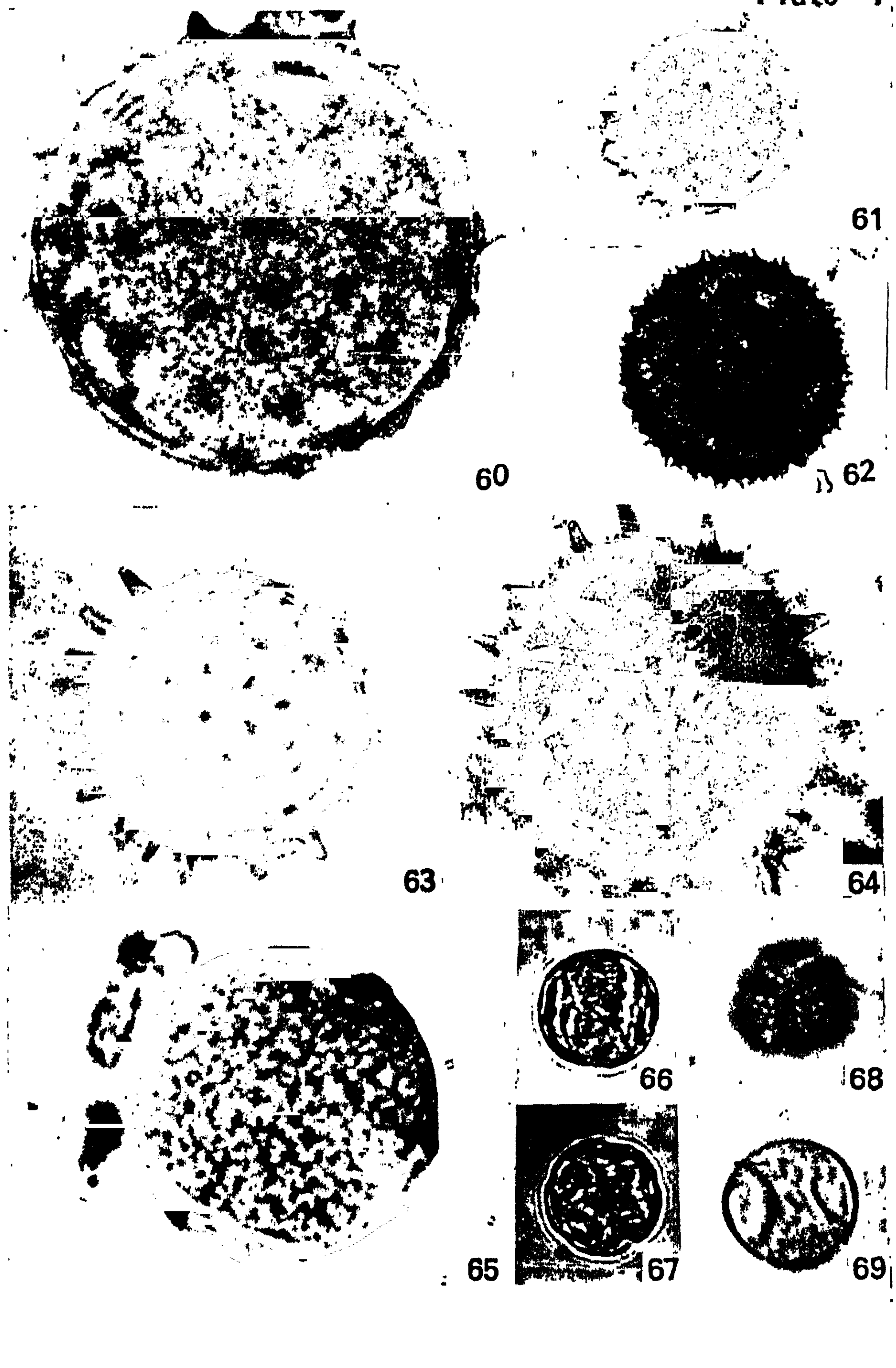

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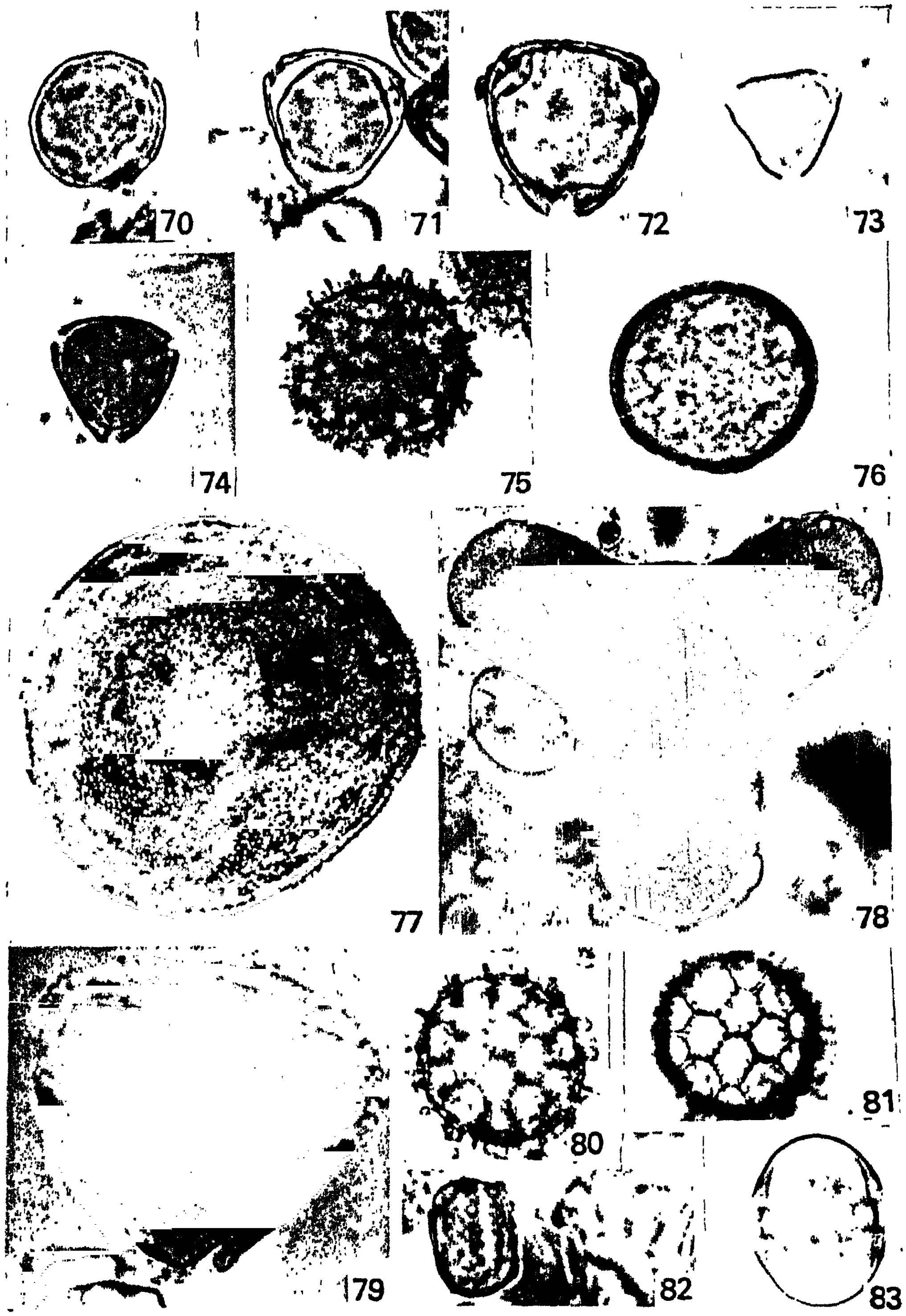

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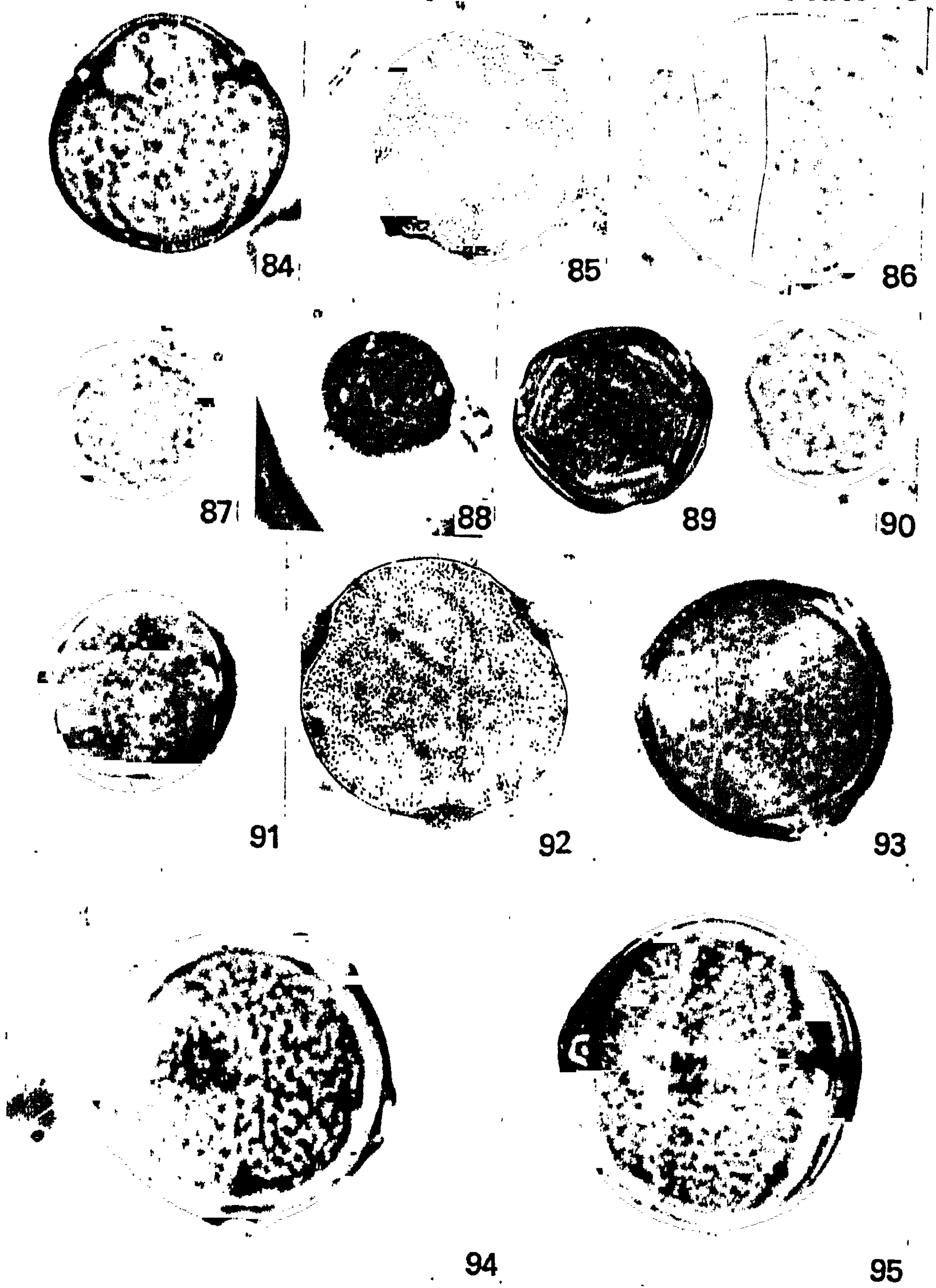

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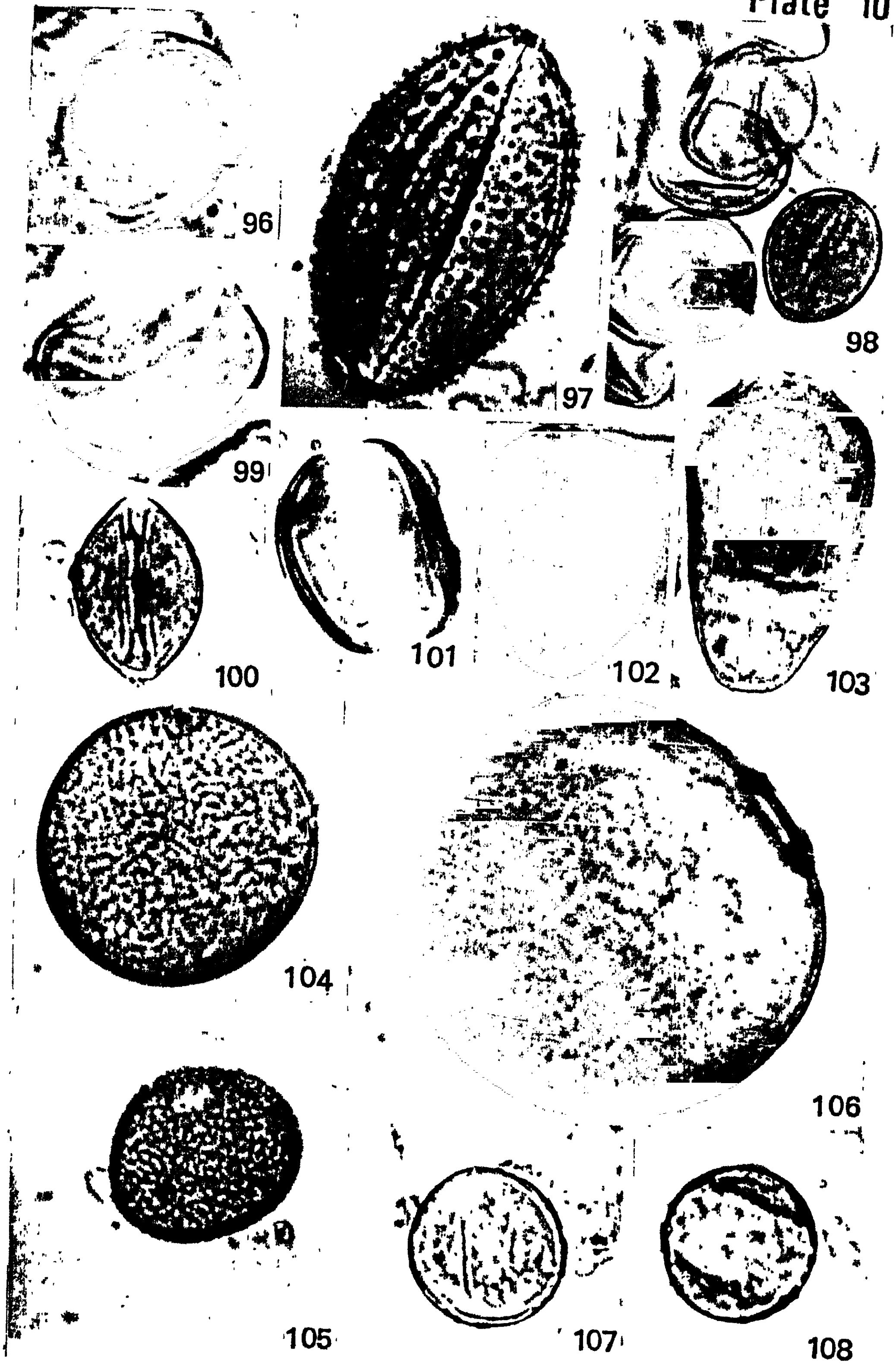

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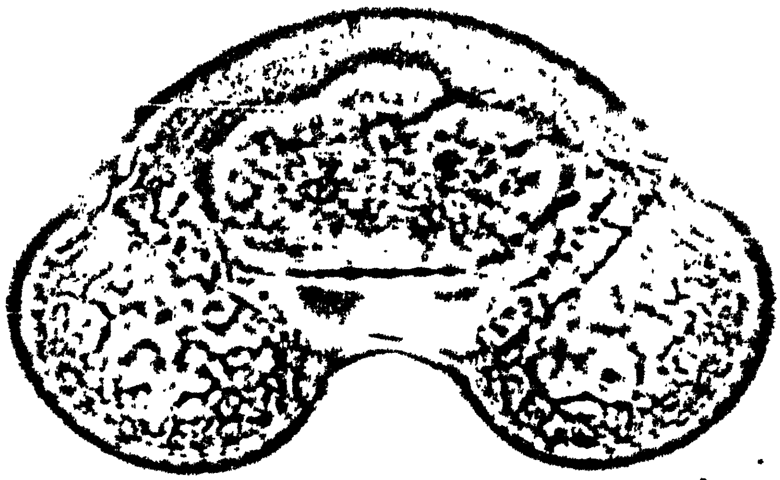

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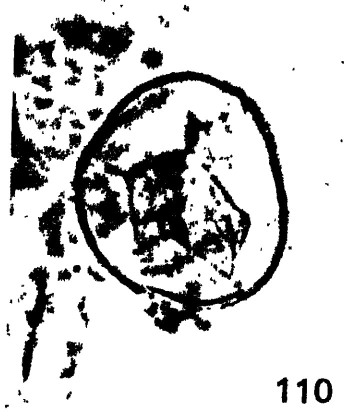

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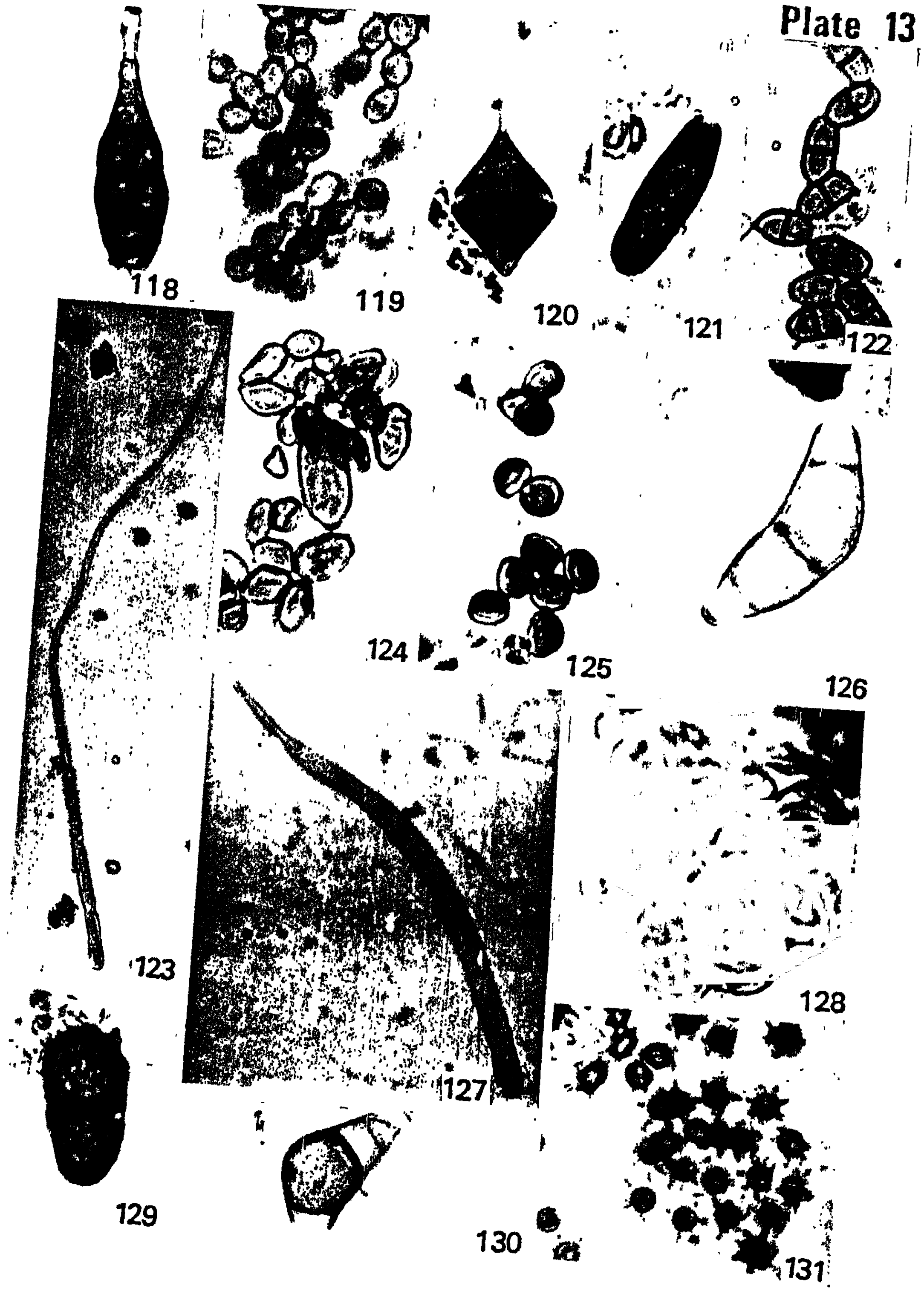

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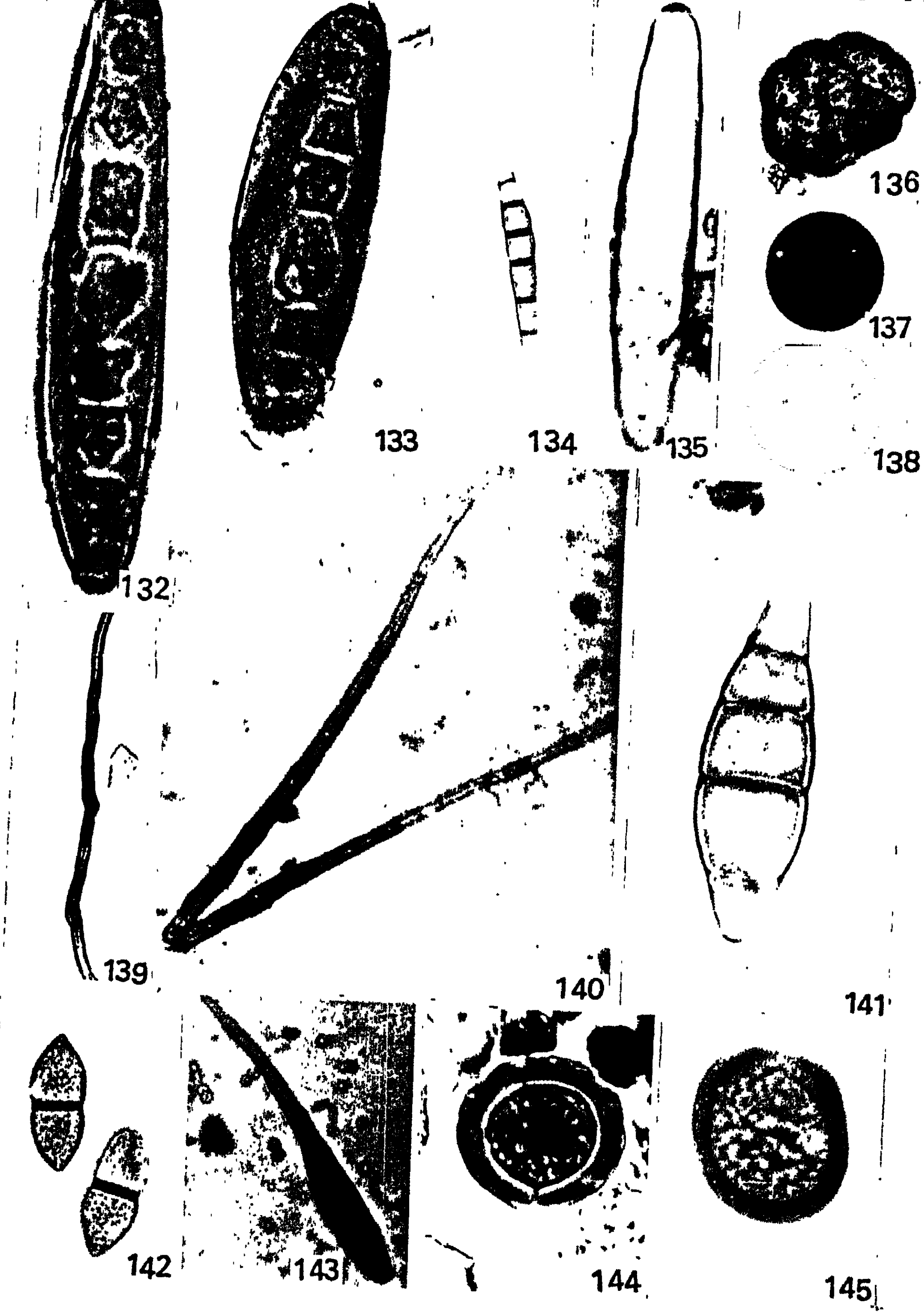

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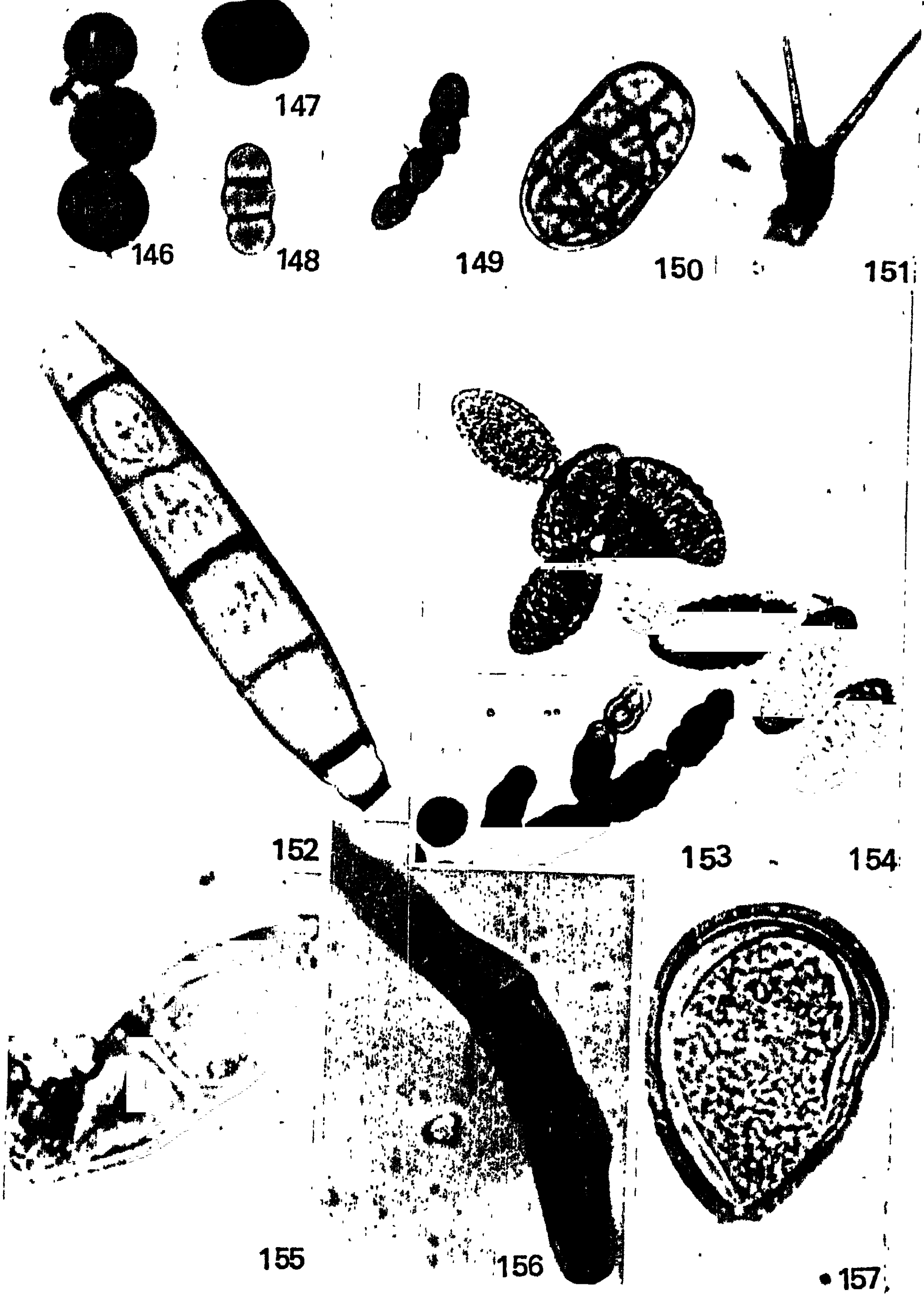

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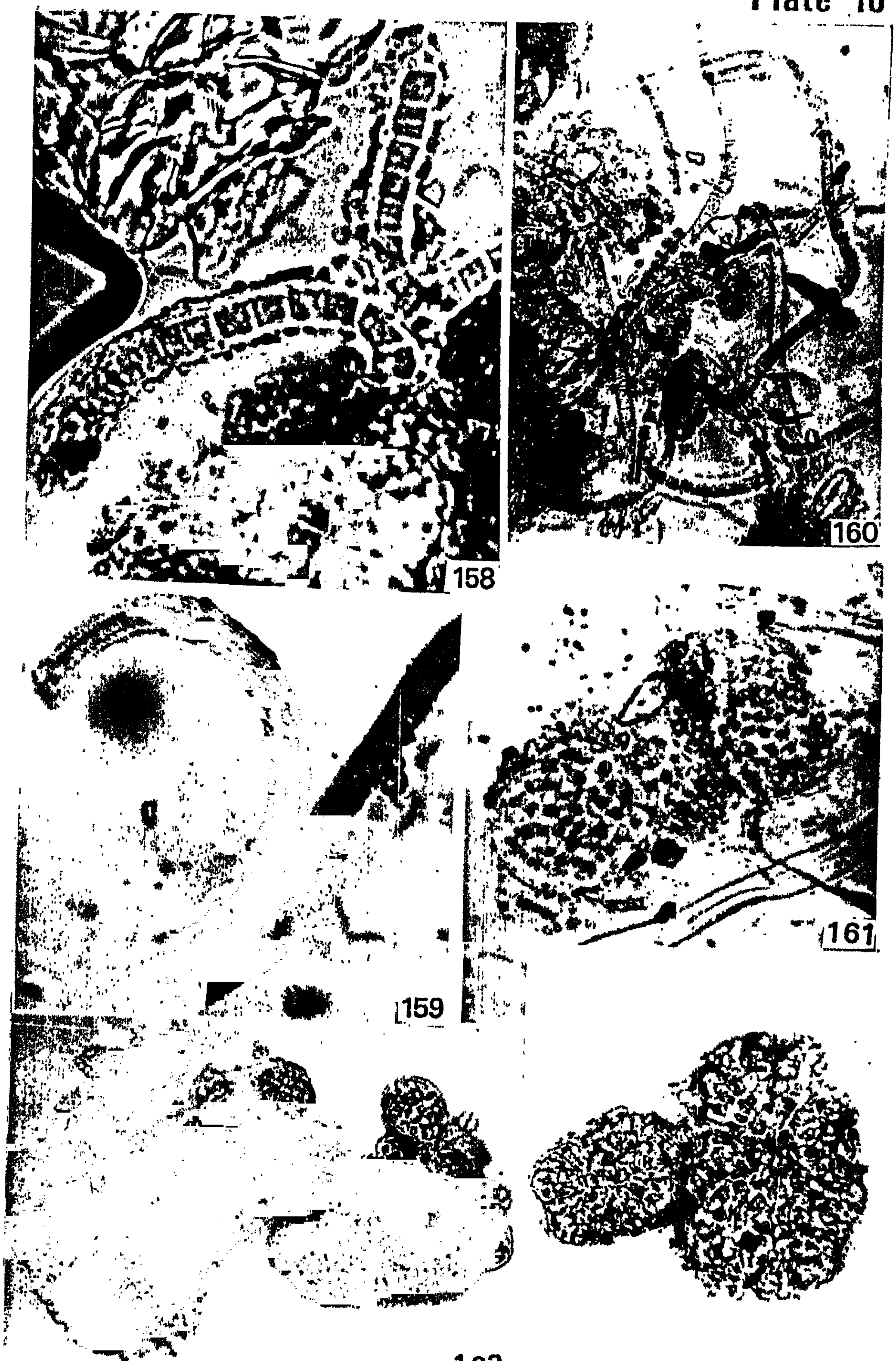

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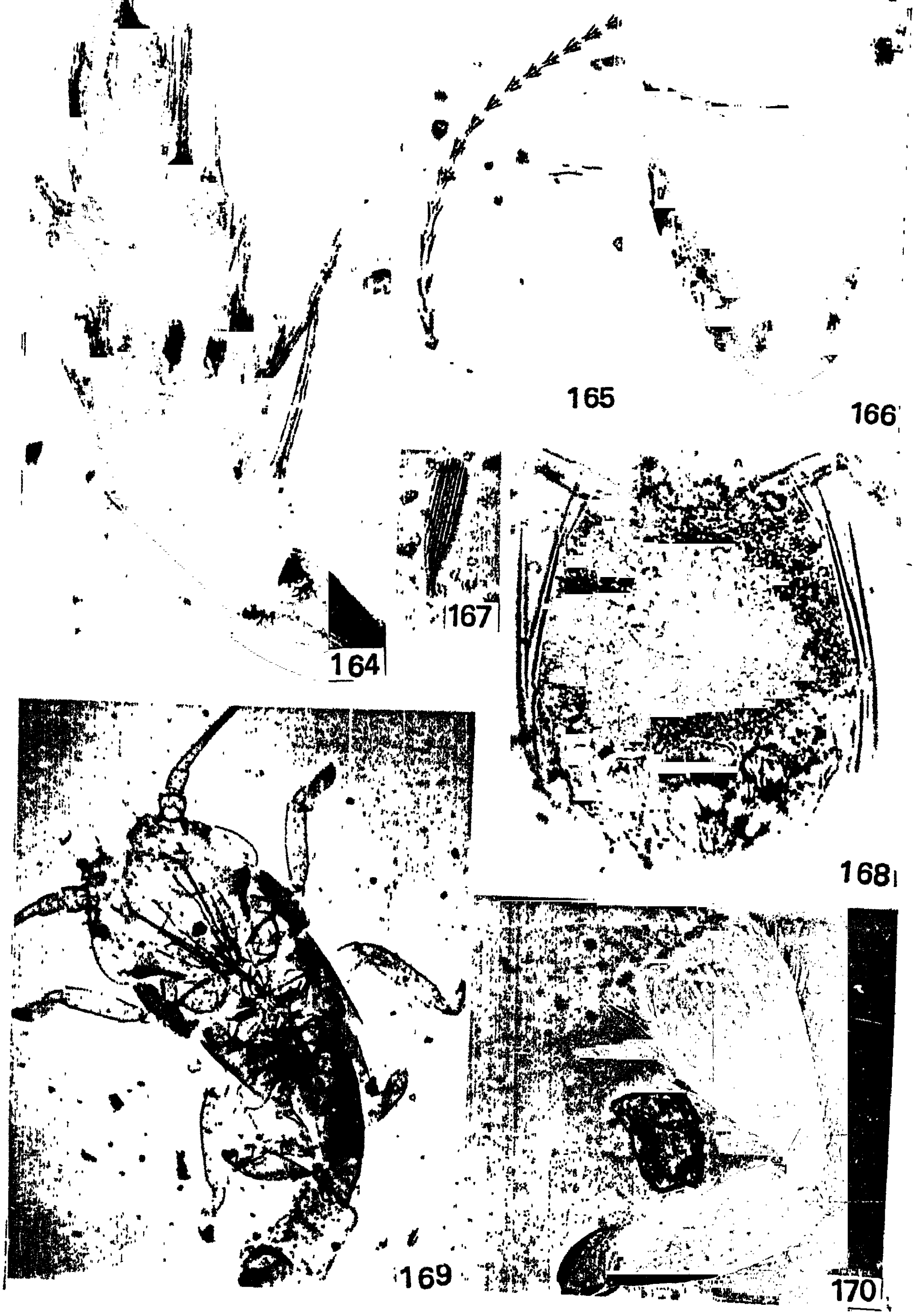

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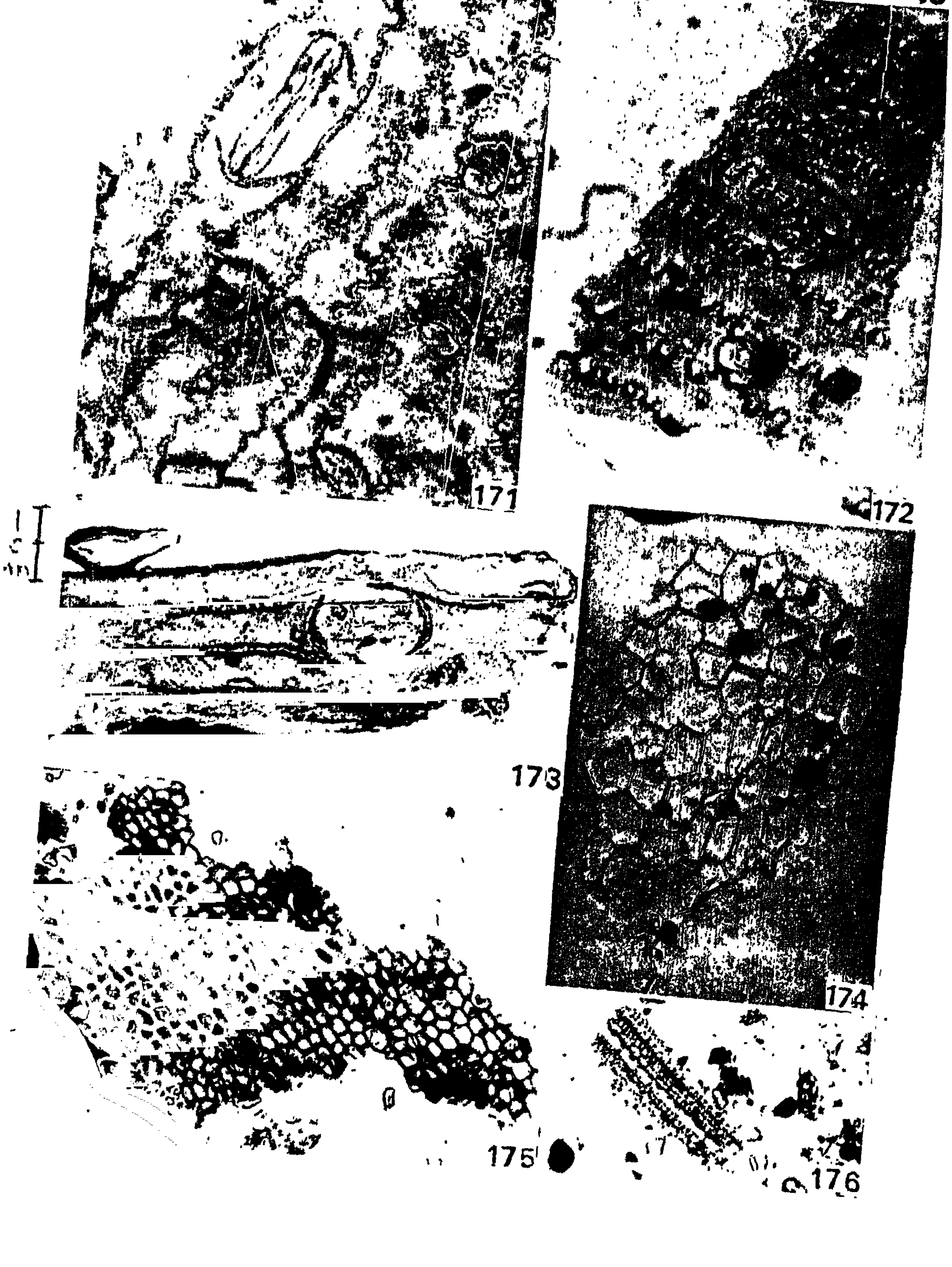

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